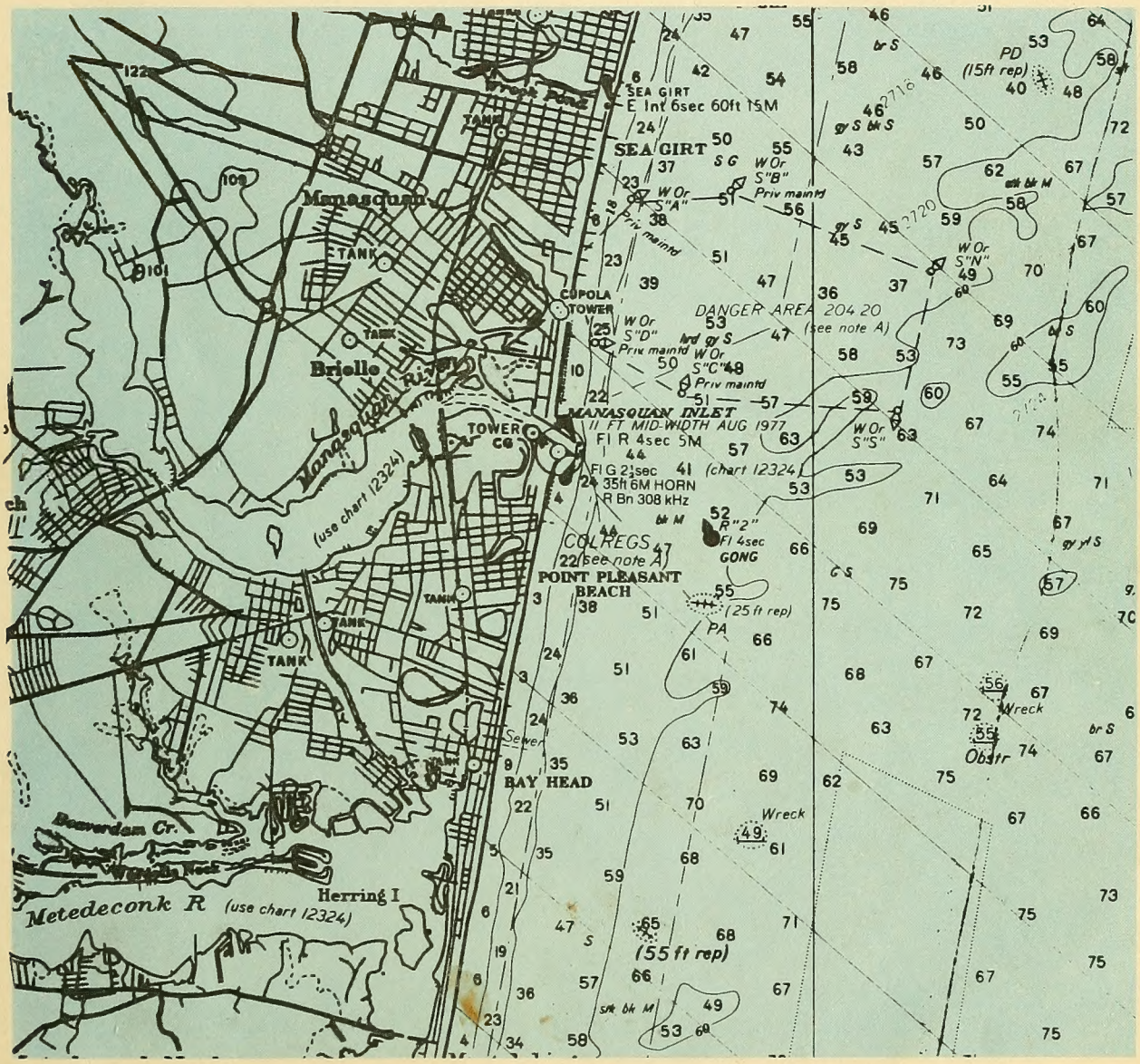
U.S. OCEAN POLICY IN THE 1970s: STATUS AND ISSUES

DOCUMENT LIBRARY
Woods Hole Oceanographic Institution



U.S. DEPARTMENT OF COMMERCE

MBL/WHOI
0 0301 0033985 9

GC
1021
.U54

U.S. OCEAN POLICY IN THE 1970s: STATUS AND ISSUES

Juanita M. Kreps, Secretary of Commerce
Jerry J. Jasinowski, Assistant Secretary for Policy
James W. Curlin, Deputy Assistant Secretary for Ocean, Resource and Scientific Policy Coordination
Robert J. Blackwell, Assistant Secretary for Maritime Affairs
Richard A. Frank, Administrator, National Oceanic and Atmospheric Administration

October 1978

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock Number 003-017-00427-9

Foreword and Acknowledgments

The ocean has played a major role in the growth of the United States—as a source of food, in the development of commerce, in the Nation's security, and as a recreational outlet. Today, in the Nation's quest to satisfy expanding needs for energy, minerals, space, food, and recreation, new demands are being placed on the ocean and coastal regions, many of which already are intensively developed. Problems relating to these demands are intensified by increasing concern about the present and future quality of the natural environment and the best use of resources—many no longer thought to be unlimited. These pressures for development are worldwide and are reflected in the continuing effort by the United Nations to reach agreement on an international law of the sea.

A decade has passed since the last systematic review of U.S. ocean policy by the Stratton Commission. During the interim, significant changes have taken place in societal values—in the equitable and best use of resources, in environmental law, in technological capabilities, and in the broadening of conflicting interests of use to an international scale. New laws have been enacted to give the Federal Government a measure of control over the use and protection of U.S. ocean and coastal resources, but many problems remain to be solved. If solutions are to be forthcoming, the Federal Government must exercise greater leadership in managing this trust on behalf of all the people.

In recognition of this situation, President Carter, in June 1977, requested the Secretary of Commerce to make a comprehensive review of U.S. ocean policy. This decision by the President was enthusiastically supported by a number of U.S. Senators and Congressmen. This report is the result of the President's request. It discusses current ocean policies in each major area of civilian ocean and coastal affairs, provides background information on the evolution of policies, describes and appraises the status of Federal ocean programs, identifies issues that need to be resolved, and reviews recommendations that have been made by various advisory commissions, councils, and other groups, including legislative proposals where appropriate. The report does not offer recommendations. It is a reference document for study and review of domestic ocean policy, and is intended to provide the background and impetus for discussion and debate of outstanding ocean policy issues. A separate appendix includes a compilation of the statutes and executive orders that form the framework of U.S. ocean policy.

Preparation of this report was coordinated under the general direction of the Secretary of Commerce, Juanita Kreps, within the Office of the Assistant Secretary for Policy, Jerry J. Jasinowski, under the supervision and guidance of James W. Curlin, Deputy Assistant Secretary for Ocean, Resource and Scientific Policy Coordianation. The study was compiled in consultation with Richard A. Frank, Administrator of the National Oceanic and Atmospheric Administration, and Robert J. Blackwell, Assistant Secretary for Maritime Affairs. Although the Department of Commerce had major responsibility for compiling the report, major contributions were made by the Department of the Interior, Department of Transportation (U.S. Coast Guard), and the National Advisory Committee on Oceans and Atmosphere (NACOA). Over 100 persons were involved. Comments were offered by a wide range of reviewers in the academic and private sectors, at State and Federal levels of government, and from the Congress.

The principal authors and their organizational affiliations are:

- Alfred W. Anderson, Office of Legislative Affairs, National Oceanic and Atmospheric Administration, Department of Commerce
- Berton J. Braley, Jr., Maritime Administration, Department of Commerce
- James W. Curlin, Deputy Assistant Secretary for Ocean, Resource and Scientific Policy Coordination, Department of Commerce

- Harry Feehan, Office of General Counsel, National Oceanic and Atmospheric Administration, Department of Commerce
- Nancy M. Foster, Office of Ocean Management, National Oceanic and Atmospheric Administration, Department of Commerce
- Bruce G. Gellin, Office of the Assistant Secretary for Policy, Department of Commerce
- Harold F. Gortner, Office of the Assistant Secretary for Policy, Department of Commerce
- Chris Heller, President's Reorganization Projects, Office of Management and Budget
- Robert C. Junghans, Office of Policy and Planning, National Oceanic and Atmospheric Administration, Department of Commerce
- Capt. William E. Lehr, Office of the Chief of Staff, U.S. Coast Guard, Department of Transportation
- Barbara Lloyd, Office of the Assistant Secretary for Energy and Minerals, Department of the Interior
- Catherine E. Meleky, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce
- Edward J. Pastula, Jr., National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce
- Richard N. Rigby, Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, Department of Commerce
- Brian J. Rothschild, Office of Policy and Planning, National Oceanic and Atmospheric Administration, Department of Commerce
- Charles F. Treat, Office of Ocean, Resource and Scientific Policy Coordination, Department of Commerce
- John T. Willis, National Advisory Committee on Oceans and Atmosphere
- Patrick H. Windham, U.S. Senate Committee on Commerce, Science, and Transportation
- William W. Windom, Office of the Naval Deputy, National Oceanic and Atmospheric Administration, Department of Commerce

Production of the study was overseen by Neil A. Benfer, Scientific and Technical Publication Division, National Oceanic and Atmospheric Administration. Production was by Carol A. Owenby, Office of the Assistant Secretary for Policy, Department of Commerce, and Debra L. Walker, National Advisory Committee on Oceans and Atmosphere.

Contents

	Page
FOREWORD	iii
CHAPTER I: INTRODUCTION	I–1
CHAPTER II: THE NATION'S STAKE IN THE OCEAN	
OCEAN RESOURCES	II–1
Fisheries	2
Oil and Gas	2
Manganese Nodules	3
Other Resources	3
OCEAN USES	4
National Defense	4
Merchant Shipping	4
Recreation	4
Other Uses and Concerns	5
SUMMARY	5
CHAPTER III: MARINE FISHERIES	
CHARACTERISTICS AND STATUS OF U.S. FISHERIES	III–1
U.S. Fishing Effort	1
Commercial Fishery	1
Harvesting	1
Processing	1
Regional Impacts	2
Domestic and Foreign Market Shares	3
Recreational Fishery	4
Foreign Fishery	4
U.S. Overseas Fishing	6
Marine Mammals	6
Fish Imports	6
Factors of Demand	7
Fish in the Food Budget	7
Fish Prices	8
Status of Representative Stocks	8
Clams	8
Crabs	8
Atlantic Groundfish	8
Pacific Groundfish	9
Gulf of Mexico Groundfish	9
Halibut	9
Herring	9
American Lobster	9
Spiny Lobster	9
Menhaden	10
Oysters	10
Salmon	10
Scallops	10
Shrimp	11
Tuna	11

Contents (continued)

	Page
FEDERAL FISHERIES ESTABLISHMENT	III–11
Fisheries Research and Information	12
Fishery Management and Conservation	14
Use of Fishery Resources and Development of the Domestic Fishing Industry	15
Assessments and Exploratory Fishing of Underused Species	16
Development of Vessel and Gear Technology and Harvesting Techniques	16
Techniques of Product Handling, Processing, and Storing	16
Assistance in Distribution and Marketing	16
Financial Assistance to the Industry	17
RELEVANCE OF FISHERIES TO THE NATIONAL INTEREST	18
International Relations	18
Food Policy	20
Environmental Protection	21
Wildlife Management and Conservation	23
Law Enforcement	24
Economic Development	25
Federal-State Relations	27
CURRENT FISHERY POLICIES AND PROBLEMS	29
Marine Recreational Fishing	29
Increasing Fishery Productivity	31
Restoration of Depleted Stocks	31
Reduction of Foreign Competition	32
Developing Underused Species	33
Resource Surveys and Assessments	33
Harvesting Techniques and Technology	33
Storage, Processing, and Product Development	33
Marketing and Economic Analysis	34
Seafood Waste Recovery	34
Fishery Cooperatives	34
Aquaculture	34
Federal Support of Fishery Research	35
Fishery Management and Enforcement	37
Consumer Education and Product Quality	40
CHAPTER IV: COASTAL RESOURCES	
INTRODUCTION	IV–1
THE COASTAL REGION	2
Physiographic Characteristics	2
Economic Activity	4
Population	5
COASTAL ZONE MANAGEMENT	7
Background	7
Coastal Zone Management Act of 1972 as Amended	9
National Policy	9
Financial Assistance	10
Coastal Zone Program Requirements	10
Federal Consistency	11
Coastal Energy Impact Program	12
Implementation of the Coastal Zone Management Act	13
Federal Agency Involvement	13
State Agencies and the Administration of Coastal Programs	14
Local Government and Coastal Zone Management	15

Contents (continued)

	Page
Consistency Provisions and State Expectations	IV–16
Coastal Energy Impact Program	17
STATUS OF COASTAL ZONE MANAGEMENT PROGRAM	20
Program Development	20
Description of State Coastal Zone Management Programs	23
Washington State Coastal Zone Program	35
Evaluation Criteria	38
ALTERNATIVE APPROACHES TO COASTAL ZONE MANAGEMENT	39
PROTECTION OF COASTAL WETLANDS	42
Pressures From New Development	42
Importance of Wetlands	42
Efforts to Protect Wetlands	43
Federal Wetland Protection	43
Rivers and Harbors Act of 1899 (Expanded Review)	43
Federal Water Pollution Control Act Amendments of 1972	44
Estuarine Sanctuaries (Coastal Zone Management Act)	45
Other Related Federal Statutes	45
State Wetland Protection	46
MARINE RECREATION	47
Public Access to the Coasts	49
Access to Public Beaches	50
Public Beach Resources	50
Expanding the Public Beach Resource	51
Proposed Federal Beach Legislation	53
Federal Programs Supporting Marine Recreation	53
Equitable Use: Private vs. Public Interest	56
Conflicting Uses	58
Role of the Private Sector	58
OCEAN AND COASTAL HAZARDS	59
Introduction	59
Natural Hazards	60
Elements of Natural Hazard Management	61
Prediction and Warning	61
Land Use Management	64
Disaster Preparedness Plans	66
Hazard Mitigation	67
Disaster Relief and Rehabilitation	68
Federal Agencies in the Natural Hazard Management System	69
SITING OF ENERGY FACILITIES ON THE COAST	71
Introduction	71
Background	72
Shortcomings of the Older Laws	72
Recent Developments	73
Sitings of Particular Kinds of Coastal Energy Facilities	73
Oil Tanker Facilities, Including Deepwater Ports	73
Outer Continental Shelf Oil and Gas	75
Liquefied Natural Gas (LNG) Facilities	75
Other Onshore Energy Facilities	76
Floating Offshore Nuclear Powerplants	77
The Role of Coastal Zone Management in the Siting of Energy Facilities	77
The California Lawsuit	78
NONFUEL MINING ON THE CONTINENTAL SHELF	80
Introduction	80

	Page
Extent and Distribution of the Resources	IV–81
Potential for Mining on the Continental Shelf	81
Environmental Impact and Conflict With Other Uses	83
State Approaches in Dealing With Offshore Mining	84
CHAPTER V: MARINE TRANSPORTATION	
INTRODUCTION	V–1
THE MARINE TRANSPORTATION INFRASTRUCTURE	2
Ports and Harbors	3
Aids to Navigation and Safety	10
Integration of Nontransportation Objectives in the Development and Operation of the Marine Transportation System	12
Major Current Issues	15
ECONOMIC REGULATION	17
Regulatory Imperatives	17
Regulation of Foreign Trade Shipping	19
Regulation of Domestic Trade Shipping	22
Other Regulatory Responsibilities of ICC and FMC	24
Major Current Issues	25
PROMOTION OF U.S. SHIPPING AND SHIPBUILDING	27
Maritime Aid Before 1936	29
The Merchant Marine Act of 1936	32
Maritime Policy After World War II	34
The Merchant Marine Act of 1970	37
General Federal Maritime Support Activities	39
Progress Under the Merchant Marine Act of 1970	43
Major Current Issues	45
CHAPTER VI: THE MARINE ENVIRONMENT	
THE OCEAN AND THE MARINE ENVIRONMENT	VI–1
Environmental Pressures	1
The Ocean as a System	3
The Oceans and Climate	4
Ocean Pollution Research and Monitoring	5
International Activities	6
GOVERNMENTAL EFFORTS TO CONTROL OR MITIGATE MARINE POLLUTION	8
Federal Marine Pollution Control Statutes	9
Ocean Dumping	11
Marine Protection, Research, and Sanctuaries Act	11
Status of Ocean Dumping	12
Dredged Material	12
Sewage Sludge and Ocean Outfalls	13
Industrial Wastes	13
Research and Monitoring Under the Ocean Dumping Act	14
Progress and Issues	15
Oil and the Marine Environment	17
Introduction	17
Vessel Source Pollution	18
Oil Spill Liability and Compensation	19
Oil and Gas Operations on the Outer Continental Shelf [OCS]	21
Legislative Authorities	21
Evolution of the Offshore Leasing Program	21
OCS Environmental Studies	22
Deep-Seabed Mining	23

Page

Introduction VI–23
Nature and Extent of the Resource 24
State of Technological Development 25
Potential and Importance to the United States 25
Importance of the Minerals 25
Economic Potential of the Resource 26
United Nations Law of the Sea Conference 27
The Federal Role and Congressional Initiatives 28
Environmental Aspects of Seabed Mining 28
Environmental Regulation in an International Arena 29
Lack of Environmental Effects Information 29
State of Knowledge Concerning Possible Impacts 29
Impacts on the Benthic Environment 30
Impacts on the Pelagic Environment 31
Impacts of Processing 32

CHAPTER VII: MARINE SCIENCE AND TECHNOLOGY

TRENDS IN NATIONAL SCIENTIFIC EFFORT VII–1
National and International Trends in R&D Funding 2
Trends in Marine Science and Technology Funding 3

STRUCTURE OF MARINE SCIENCE AND TECHNOLOGY—
PERSPECTIVES OF THE FIELD 4

FEDERAL MARINE SCIENCE AND TECHNOLOGY ESTABLISHMENT .. 5
National Research Facilities 7
Federal Research Laboratories 7
NOAA Laboratories 7
Laboratories of Other Ocean-Related Agencies 14
University-Related Laboratories 14
The Oceanographic Fleet 15
University National Oceanographic Laboratory System 16
Underwater Habitats and Submersibles 18
Habitat and Diving Activities 18
Submersible Technology 18
Ocean Engineering and Technology Development 19
Technology and Information Transfer 23

MARINE RESEARCH PROGRAMS 25
National Science Foundation 25
Division of Ocean Sciences 25
Division of Earth Sciences 27
Division of Atmospheric Sciences 27
Division of Polar Programs 27
The Sea Grant College Program 27
Other NOAA Marine Research Programs 28
Navy Ocean Science Program 28
Department of Energy 29

INTERAGENCY COORDINATION OF MARINE SCIENCE
AND TECHNOLOGY 31

CHAPTER VIII: MARINE EMPLOYMENT, EDUCATION, AND TRAINING

INTRODUCTION VIII–1
Present and Projected Employment 1
Development of Federal Role 1

EDUCATION AND TRAINING OF MARINE PROFESSIONALS VIII–7
Present Federal Policy 7
Federal Support 7
Role of the Universities 7
Marine Affairs 8
Present Marine Education System 9
Three Major Federal Programs 10
Office of Naval Research 10
National Science Foundation 11
Sea Grant 11
Management of the Federal Marine Education Effort 12
Data and Information 12
Coordination 14
Major Current Issues 14
MARITIME OFFICER TRAINING 15
Present Federal Policy 15
Sources and Employment of Merchant Marine Officers 16
Controversy Over Maritime Manpower 17
Licensing and Retraining 21
Major Current Issues 22
VOCATIONAL AND TECHNICAL TRAINING 23
Present Federal Policy 23
Federal Programs 24
Major Current Issues 25
PUBLIC EDUCATION 26
College Preparation Programs 26
General Marine Education 26
Present Federal Policy 26
Federal Programs 27
Recent Developments 27
Public Information 28
Federal Policy 28
Programs and Recent Developments 29
Major Current Issues 29

CHAPTER IX: ORGANIZING THE NATIONAL OCEAN EFFORT

INTRODUCTION IX–1
MORE EFFECTIVE ADMINISTRATION: AN ELUSIVE GOAL 2
Trends in Governmental Organization 2
The Trilogy of Organization 3
FORMULATION OF OCEAN POLICY 3
Role of the White House in Ocean Policy 4
Historical Role of the White House in Ocean Policy 5
Marine Science Council 5
Science Advisory Structure 5
Present White House Policy Organization 6
Policy Councils 6
Office of Science and Technology Policy 8
Council on Environmental Quality 8
Ocean Policy Unit for White House: An Enduring Proposal 9
Marine Science or Marine Affairs Council 10
Office of Maritime Affairs Coordinator 10
White House Councils: Concept in Perspective 11
Advisory Committees 12

National Advisory Committee on Oceans and Atmosphere IX–12
National Academies of Sciences and Engineering 14
ORGANIZATION OF FEDERAL OCEAN PROGRAMS 15
Present Organization: A Point of Departure 16
Split Jurisdiction: A Special Organizational Problem 22
Organizational Options and Principles 23
Organizational Structure and Status 23
Independent Agency or Cabinet-Level Department 24
Integration by Function or Resource 24
Organization by Function 24
Organization by Resource 27
Separation of Development and Regulatory Activities 27
RECOMMENDATIONS FOR REORGANIZATION 28
Stratton Commission Recommendations (1969) 28
President's Advisory Council on Executive Reorganization—The Ash Council (1971) 30
National Advisory Committee on Oceans and Atmosphere: Third Annual Report (1974) 30
The Moore Proposal (1976) 31
The Hollings Proposal: Department of Environment and Oceans (1976) 31
Multipurpose Reorganizational Proposals (94th Congress): Department of Natural Resources—Energy—Environment 32
Outer Continental Shelf Management Reorganization 33
Need for Long-Range Resource Planning 34
SETTING PRIORITIES: THE BUDGET PROCESS 34

Pages: xii, 328

Chapter I: Introduction

It has been nearly a decade since the Commission on Marine Science, Engineering, and Resources (Stratton Commission) released its report *Our Nation and the Sea*. During the interim, significant changes have occurred in the U.S. use of the ocean and coastal resources. Because of dwindling land-based resources and changes in world economic order, the United States has become more dependent on the ocean for fuel, food, and routes of commerce. An affluent population continues to migrate to the coastal region, thus placing burdens upon the coastline for recreation, homes, and industrial sites.

Since 1969, when *Our Nation and the Sea* was published, the Congress has enacted a number of statutes which affect the use of the ocean and its resources, such as the Coastal Zone Management Act of 1972, Deepwater Ports Act of 1974, Fishery Conservation and Management Act of 1976, and the Outer Continental Shelf Lands Act Amendments now pending in Congress. Other legislation enacted to protect, at least in part, the ocean environment and certain marine species include the National Environmental Policy Act, Ocean Dumping Act, National Ocean Pollution Research and Development and Monitoring Planning Act of 1978, Marine Mammal Protection Act, Federal Water Pollution Control Act Amendments of 1972, Ports and Waterways Safety Act, and the Clean Water Act of 1977. This legislation forms a new body of law that focuses on the conservation and protection of the ocean and coastal regions and their resources.

During the same period, the United Nations Law of the Sea Conference has met repeatedly to seek international agreement on a new law of the sea. Progress has been painfully slow on the complex issues dealing with deep seabed mining, passage of vessels through straits, access to coastal waters for scientific studies, protection of the marine environment, resolution of conflicts, and creation of economic resource zones. The outcome of this international effort, begun in 1973, is still uncertain. In the meantime, many nations have moved unilaterally to establish jurisdiction over resources and uses of the ocean off their shores. It is clear that customary international law is moving toward expanded control of the offshore areas by the adjoining coastal nations.

In the 1960's, ocean policy was synonymous with policies pertaining to marine science and engineering. The tone was set by the space age and the Nation's faith in science and technology as the key to the future. The Stratton Commission's report understandably focused on developing the Nation's ocean science and engineering capability in order to use the ocean's resources and protect the marine environment. The assumption at that time was that a modest investment in technology would result in profitable use of ocean resources. We have since learned that it is more likely that economic incentives are a more powerful inducement to technological development than had been realized, and that technological development alone will not compensate for a lack of commercial potential.

Since the "blueprint" for U.S. ocean development was drawn by the Stratton Commission in 1969, national needs have changed. Ocean resources have taken on new significance, a phalanx of new legislation has created a body of domestic "ocean" law, and international boundaries for the purpose of conservation and protection of marine resources and the environment are better defined.

It is often said that the United States has no national ocean policy. This is not so. U.S. ocean policy is the most sophisticated among the maritime nations. Its complexity, however, tends to confuse and perplex the casual observer. The framework of U.S. ocean policy is contained in a myriad of statutes that authorize scores of programs which are administered by numerous departments and agencies of the Federal Government. This framework was developed in response to individual ocean problems as they arose over time.

It has been the Congress that has borne the burden of developing the Nation's ocean policy in recent years. In general, past Presidents have paid little attention to the ocean as a resource to be managed and protected.

As the emphasis on the ocean changes from one centered in marine science and technology to one concerned for the wise use, conservation, and protection of ocean resources and the marine environment, it is appropriate to review the Federal laws, institutions, and programs that have been developed since *Our Nation and the Sea* was published.

In many ways, this study is a progress report of what the Stratton Commission began in 1965. It is not intended to, nor could it, supplant the work of that prestigious group. Rather, the study is intended

to achieve three specific objectives: (1) identify and delineate the components of U.S. ocean policy; (2) describe the Executive programs and activities that implement this policy; and (3) identify outstanding issues and problems that must be addressed. The study does not contain recommendations for possible future action. Recommendations for Government action must come from collaboration among the Federal agencies, States, and public and private interests that have a stake in the future of the ocean and its resources. The contents are intended to contribute to the debate which must now occur in developing a new ocean agenda. Recommendations made by other organizations, such as the National Academy of Sciences, National Academy of Engineering, commissions, committees, councils, academicians, and the Congress, are included to emphasize the issues.

Thus, the study serves (1) as a means for generating discussion and debate over issues of ocean policy, (2) as a reference and source for further research into U.S. ocean policy, and (3) as input to the development of options and alternatives for new directions in national ocean policy. Major Governmental organizational issues are avoided, because they are being dealt with currently by the President's Reorganization Project in a comprehensive framework. Seven substantive chapters deal with the following subjects:

- Marine Fisheries
- Coastal Resources
- Marine Environment
- Marine Science and Technology
- Marine Transportation
- Marine Employment, Education, and Training
- Organizing the National Ocean Effort

An overview of these chapters is available as an executive summary. A separate appendix is being prepared to summarize the statutes and executive documents that relate to and form the framework of U.S. ocean policy.

Chapter II: The Nation's Stake in the Ocean

From its beginning, the United States has had an intimate involvement with the ocean. The earliest settlements were coastal communities that depended on the ocean as a link to the old world. As a young Nation, America made an early mark in international affairs during the Clipper Era when U.S. vessels dominated world shipping.

The country has come to rely on the ocean not only for transportation, but for food and energy resources and as a major factor in our national defense. This reliance has increased in recent years, in part because of growing shortages of land-based resources.

Today the ocean is a mecca for recreation. Coastal areas frequently are crowded during the summer as a more affluent and leisure-oriented society turns to the water. The Nation's major industrial centers and urban population concentrations also are centered in the coastal region.

Greater emphasis on ocean-related activities is evident in the search for solutions to socioeconomic problems. Shortages of domestic energy resources have increased our dependence on imports of foreign oil and natural gas. Development of oil and gas reserves in the Outer Continental Shelf is a top national priority, in part to offset our dependence on foreign sources. Projected mineral shortages have precipitated plans to use deep sea-floor minerals such as manganese nodules. There is increased interest in fish as a source of low-fat protein as Americans consume increasing amounts of fish and fish products.

Along with increased use of the ocean in recent years has come an appreciation of the need to protect coastal and estuarine waters. Ocean dumping is now regulated, and efforts to clean up the Nation's waters are beginning to have an effect: some coastal waters have been restored to a healthy condition. However, the ocean is still a major recipient of wastes from industrial societies. The long-term effects of petroleum and chemicals in the ocean are still largely unknown.

Thousands of people derive their livelihood from working on or near the ocean. The ocean also touches the lives of millions who buy goods transported on the ocean, visit the ocean for recreation, and consume products developed from ocean resources.

The ocean has an intrinsic value in that the climates of the world are largely determined by oceanic and atmospheric currents that transport heat. Waters of the ocean also are instrumental in controlling gas exchange to maintain the balance of oxygen and carbon dioxide in the atmosphere.

While the potential for ocean resource development is great, some past predictions about this potential have been exaggerated. Projections in the 1960s about feeding the world from the sea, extracting vast amounts of mineral wealth, and other solutions sought from the new field of oceanography were over-dramatized.

The Nation's stake in the ocean is increasing in economic terms, and it is likely to continue to expand. The central issue is whether the governmental apparatus and the private sector as they now exist are sufficient for the amount, extent, and intensity of present and prospective uses of the ocean. A parallel issue also exists: what is the proper role of the Federal Government vis-a-vis the States and private sector in meeting the ocean needs of the Nation?

Ocean Resources

The development of ocean resources depends on a sound base of science and technology and on reasonably accurate assessments of the extent and location of the resources. These factors were reviewed in a number of reports published since the mid-1960s. In 1964 the National Academy of Sciences issued a report. *Economic Benefits from Oceanographic Research,* which attempted to correlate increases in the economic value of ocean activity with investments in scientific research. Using a complex formula, the Academy estimated that a direct return on a 20-year investment in oceanographic research would be more than three times the same investment yielding a return at 10 percent compound interest.

Later in 1964, the National Security Industrial Association (NSIA) reviewed the need for ocean resource development in terms of the U.S. trade bal-

ance and the reduction of our dependence on imports of specific commodities.[1] In 1966 the Panel on Oceanography of the President's Science Advisory Committee (PSAC) expressed alarm about the growth of world population vis-a-vis food supplies and suggested that increasing the availability of fish products might help reduce protein deficiencies.[2] In 1968 a study prepared for the National Council on Marine Resources and Engineering Development examined the development potential of fossil fuels, minerals, and other nonliving resources of the U.S. continental shelves.[3] Other Council studies reviewed more specialized aspects of marine development, such as the economics of fish protein concentrate, economic aspects of solid waste disposal at sea, economic factors in coastal zone development, and multinational investment in ocean activity.

The optimism about ocean resource development that generally characterized the 1960s was exemplified in a Department of the Interior pamphlet, *Marine Resources Development, A National Opportunity*. Published in 1969, this pamphlet used then-current estimates of population growth to project a turn-of-the-century U.S. population of 315 million —considerably higher than current estimates. It concluded that the increased demand generated by a population of this size could only be met by expanded exploitation of ocean resources. Estimates of ocean resource potentional included the statement that "even the most conservative estimates of the food potential of the sea predict that the ocean can supply minimum animal protein needs for twice the present world population. If we can learn how to use the much more abundant marine animals, not now harvested at reasonable costs, we might increase this harvest ten-fold." The pamphlet was similarly optimistic about the potential of marine fossil fuels and minerals.

An attempt to assess more realistically the value of ocean resources and ocean uses to the United States was undertaken in 1974 by Robert R. Nathan Associates for the Senate National Ocean Policy Study. The report, *The Economic Value of Ocean Resources to the United States,* attempted to assign dollar values to the various activities involving the ocean. Where no resoure estimates existed, the consulting firm made the best estimates it could. The study found that primary economic activity involving ocean resources totaled $7.5 to $7.8 billion in 1973 dollars. Projections for 1985 were $23 to $26 billion. The figures do not include a value for use of the ocean for waste disposal.

The three broad categories of use were living resources ($800 million in 1972), mineral resources ($3.4 billion in 1973), and nonextractive ocean uses ($3.5 billion in 1972).

Projections of ocean use at the end of the century by Nathan Associates were that energy use, particularly floating nuclear powerplants, would surpass all other uses except production and transportation of oil and natural gas.

Fisheries

Fish and shellfish rank relatively low as sources of protein in the U.S. diet, after meat, poultry, and dairy products. The demand for fish and shellfish, however, has risen modestly in recent years. In the 1950s and 1960s, per capita consumption averaged less than 11 pounds per year. In the first 7 years of the 1970s, per capita consumption was somewhat over 12 pounds per year; consumption of fish caught for recreation adds to this figure.

U.S. fish consumption has increased despite rising prices of fish and fish products which have generally exceeded price increases for meat and poultry. The consumption rise can be attributed to growing demand for high-cost fish and shellfish varieties and convenience foods, such as frozen fish fillets, fish sticks, and breaded shrimp. These consumption patterns have resulted in the concentration of demand on shellfish, tuna, salmon, and groundfish. These species accounted for 81 percent of the total value of U.S. landings for 1976. The same species also accounted for over two-thirds of the cost of imports of edible fish that year.

In 1976, a total of 63 percent of the U.S. supply of edible fishery products was imported, and the balance of payments deficit for all fishery product imports was $1.9 billion.

Oil and Gas

One of the major worldwide problems of the 1970s has been the "energy crisis." This problem is the result of escalating demand on limited resources of oil and natural gas. Because of diminishing domestic resources in the face of increasing demand,

[1] National Security Industrial Association, Ad Hoc Committee on Ocean Science and Technology, *A National Ocean Program*. Washington, D.C., 1964.

[2] Report of the Panel on Oceanography of the President's Science Committee. *Effective Use of the Sea*. Washington, D.C., Government Printing Office, 1966.

[3] Economic Associates Incorporated, for the National Council on Marine Resources and Engineering Development. *The Economic Potential of the Mineral and Botanical Resources of the U.S. Continental Shelf and Slope*. Washington, D.C., 1968.

the United States has relied on foreign oil imports to make up the shortfall in domestic supplies.

In 1977, 4.2 billion barrels were imported at a cost of $42.1 billion; natural gas and ethane imports cost an additional $1.9 billion. One means of reducing the rise in these balance of payments deficits is increased domestic production of oil and natural gas while alternative energy sources are being developed. Imports now provide about half of U.S. petroleum consumption; therefore, using the untapped oil and gas reserves of the U.S. continental shelves, which are the major new domestic source, has assumed a new urgency.

U.S. Geological Survey (USGS) figures show that 1976 total oil production from the U.S. continental shelves was 462.9 million barrels, 32 percent of it from State lands and 68 percent from the Outer Continental Shelf (OCS). Offshore natural gas production in 1976 was 4.296 trillion cubic feet, 16 percent from State lands and 84 percent from the shelf.

To increase OCS oil and gas production, the Department of the Interior has accelerated its offshore leasing schedule. The latest official estimates of OCS reserves, released in December 1974, placed demonstrated and measured offshore oil reserves at 3.2 billion barrels, with another 3 billion in inferred reserves. At that time, the USGS estimated there was a 95 percent probability of 10 billion barrels in undiscovered recoverable offshore reserves and a 5 percent probability of up to 49 billion barrels. The value of offshore natural gas in demonstrated and measured reserves was stated as 36 trillion cubic feet with another 67 trillion cubic feet contained in inferred reserves. Undiscovered offshore gas reserves were estimated as 0.42 trillion cubic feet, 95 percent probable, and 181 trillion cubic feet, 5 percent probable. An updated estimate is to be released in 1978.

Manganese Nodules

The greatest potential for the development of marine hard minerals is provided by manganese nodules on the deep-sea bottom. These nodules contain four principal minerals: manganese, nickel, copper, and cobalt. The most promising nodule beds appear to be within a belt on the floor of the North Pacific. The quantity of nodules in this belt, rich in copper and nickel, has been estimated by the National Academy of Sciences at 15 billion tons.[4]

In 1976 the world production of primary nickel was 920,000 short tons. The United States used 159,700 short tons but produced only 13,900. The balance was imported, primarily from Canada.[5] World demand for nickel is growing 3.5 percent annually. This rate of consumption could result in the commencement of economically viable manganese nodule mining operations in the mid-1980s.

Periodically the United States imports a percentage of its copper requirements, largely from Chile and Peru, but generally copper is not now in short supply in this country. Manganese, the major element in ocean bottom nodules, is of interest to the steel industry. The United States used 12.8 million short tons in 1976, but produced only 50,000 short tons. Most imports came from South Africa and Gabon.[6] Cobalt is used in small quantities in the United States, but is vital to the steel industry. Virtually all cobalt is recovered as a byproduct of copper or nickel. There is no domestic primary production of cobalt. In 1976 the United States imported 16.5 million pounds of the mineral, most of which comes from Zaire and Zambia.[7]

Four international consortia, each including U.S. firms, have been formed to begin deep-ocean mining operations. These consortia have invested $30 million to $50 million each in research and development to improve mining technology. Environmental impact assessment work has begun, and additional local assessments can be made as sites are chosen. One major impediment to development remains: the resolution of law-of-the-sea questions concerning jurisdiction over operations in the deep ocean outside national jurisdiction.

Other Resources

Other ocean resources also have some economic potential. Some 1 billion short tons of sand and gravel are used annually in the United States for construction. Much of this material is derived from rivers and streams in various parts of the country. Because of the costs of transportation, it is normally used in the local area. Small amounts have been obtained from offshore sources, often for use in beach replenishment. Offshore sand and gravel mining may be of some importance in future marine development. There are sulfur deposits off the coast of Louisiana, but their economic value has been diminished considerably as the result of large sulfur sur-

[4] National Academy of Sciences. *Mineral Resources and the Environment.* Washington, D.C., 1975, p. 141.

[5] Department of the Interior, Bureau of Mines. *Nickel 1977.* MCP–4, July 1977.

[6] Department of the Interior, Bureau of Mines, *Manganese 1977.* MCP–7, October 1977.

[7] Department of the Interior, Bureau of Mines, *Cobalt 1977.* MCP–5, July 1977.

pluses produced by the removal of sulfur from fossil fuels.

Other marine resources with economic potential now or in the perceivable future are magnesium, which is extracted from seawater, and varieties of seaweed such as kelp. These marine plants are harvested and processed into commercial products. Cultivation of kelp has also been proposed to acquire fuel for use in generating energy, but its prospects for energy production on an economic basis are questionable.

In addition to these resources, high expectations in the 1960s led to Federal efforts to obtain freshwater from brine and ocean waters and to mine gold and other heavy elements in subsea placer deposits. These efforts were discontinued, and there is no reason to believe they will be resumed in the foreseeable future.

Ocean Uses

Only a part of the U.S. stake in the ocean is bound to harvesting its resource wealth. Although the United States is not an insular nation, as England and Japan are, the United States is more dependent today on the oceans for defense, trade, recreation, and other national needs.

National Defense

A substantial ingredient of the U.S. stake in the ocean is the defense it provides as a natural barrier to military invasion. However, the effectiveness of the ocean in this role depends on the maintenance of a strong naval posture. Today, naval power depends on advances in ocean science and technology, many of which yield economic or social benefits in addition to supporting defense requirements. The Navy has, therefore, become a major contributor to the development of a number of ocean activities, civil as well as military.

Merchant Shipping

The role of merchant shipping in the U.S. economy is demonstrated by the magnitude of its waterborne trade. In 1976 U.S. waterborne foreign export commerce consisted of 282.8 million short tons valued at more than $64 billion. In the same year, waterborne imports totaled 517.5 million short tons with a value of almost $81 billion. In addition to this foreign trade traffic, 232.5 million short tons were shipped coastwise in domestic ocean waters during 1976 and another 140.3 million short tons were shipped in Great Lakes waters.

Petroleum shipping has become especially important as dependence on overseas energy sources has increased. Furthermore, a large portion of coastwise shipping also consists of petroleum transportation, and the prominence of domestic petroleum shipping is likely to grow as distribution requirements continue to expand.

A number of projections indicate that foreign trade will continue to grow in response to national and international economic pressures. Currently, however, only about 5 percent of U.S. foreign trade is shipped in U.S.-flag carriers. This has aroused concern about our ability to meet our shipping requirements in the event of another major war. This concern, in turn, has prompted efforts to increase the capacity and efficiency of our merchant fleet, but it now appears unlikely, with continued growth in U.S. trade, that the U.S. fleet will be able to carry a significantly higher percentage of the Nation's foreign commerce in the foreseeable future.

Recreation

The U.S. population in 1976 had increased by some 40 percent since 1950. Over the same period of time, the constant dollar value of the gross national product increased over 137 percent and median family income increased over 90 percent, also in constant dollars. These trends, combined with increasing leisure time and greater mobility, have resulted in an accelerating growth in outdoor recreational activity, much of it along the seaboard and the shores of the Great Lakes.

Thirty of the 50 States border the oceans or Great Lakes. In 1970, about 85.5 million people or 42 percent of the total population lived within easy commuting distance of the oceans or Great Lakes. This population distribution generates a wide-ranging recreational use of shoreline areas and coastal waters by coastal residents, to which must be added the activities of vacationers from inland areas. These activities have a high personal value for those involved, and major economic value for coastal communities and the recreation industry.

Estimates of expenditures for marine-related recreation are difficult because data on recreational expenditures do not distinguish between coastal and

inland activities. Despite the general lack of economic data on strictly marine-oriented recreation, the data that do exist, combined with information on the geographic distribution of the population, indicate that direct and indirect expenditures for marine recreation have a sizable economic impact. The Nathan study estimated consumer expenditures on ocean recreation in 1972 at $4.1 billion.

The 1965 National Survey of Outdoor Recreation published by the Bureau of Outdoor Recreation indicated that the average American spent 2.26 days fishing, 1.58 days swimming in the ocean, 0.16 days sailing, 1.56 days motorboating, and 0.43 days water skiing.

The Heritage Conservation and Recreation Service (formerly the Bureau of Outdoor Recreation) estimates that marine sport fishing expenditures were $3.4 billion in 1975. The economic impact of sport fishing on marine recreation, however, results not only from the sales of fishing, boating, diving, and other specialized equipment, but from expenditures for food, lodging, gasoline, souvenirs, and the myriad of other goods and services required by vacationers and weekend visitors.

Other Uses and Concerns

In the forefront of today's concerns about ocean and coastal usage is the present and prospective siting of major energy production facilities. The availability of cooling water and discharge areas, proximity to major markets, and availability of transportation facilities contribute to a concentration of energy plants in the coastal region. Current expansion of Outer Continental Shelf oil and gas drilling, continued growth in energy demands requiring new nuclear and fossil fuel electric generating plants, as well as prospective use of the nearshore waters as sites for floating powerplants and deepwater ports, all represent increased reliance on the coastal area for energy supplies. This increased reliance causes problems, some environmental in nature, others of a social and economic type. As a result, major public controversies surround many proposed coastal energy facility sites.

The ocean has long been used as a receptacle for wastes. Disposal of municipal and industrial wastes in the oceans is deemed by many to be acceptable as long as waste disposal is controlled to prevent environmental degradation. Ocean waters can absorb tremendous quantities of the waste products of civilization. There is a real economic offset value for these uses, although it is nearly impossible to evaluate. Although the scientific data to determine the limits of the ocean's absorptive capacity are just now being developed, the data indicate that the ocean has been severely strained in some coastal areas. A major concern in this respect is the quantity of pollutants entering the ocean from rivers and streams, and even from the atmosphere. Our stake in the ocean includes not just its uses and resources, but its preservation as a resource.

The most publicized causes of environmental concern have been oil pollution resulting from drilling operations or from maritime accidents involving oil tankers, such as the sinking of the *Torrey Canyon* in the late 1960s off the coast of England or of the *Amoco Cadiz* in March 1978 near the French coast. Concern about the marine environment, however, extends beyond oil pollution to the destruction of estuarine and wetland fish-breeding habitats, overfishing of certain fish and marine mammal species, ocean dumping of waste products in areas where they may cause environmental pollution, and environmental attention resulting from the operation of powerplants. These concerns have led to regulatory activities to reduce the potential for harm to the ocean environment.

Summary

Throughout its history, the United States has made significant use of the ocean. With the advent of the science of oceanography in the 1930s, this use has gradually grown, propelled in part by national defense reasons and in part by economic incentive. Now, commercial use of the ocean is a major component of the national economy. There are traditional uses such as ocean transportation and fishing plus newer uses such as offshore oil and gas exploitation. Recreational use of coastal areas has grown rapidly in recent years. Concentrations of population and industry along the coast have contributed to the damage of ocean coastal waters in some areas. Scientists meanwhile work to advance our understanding of the composition of the ocean, as well as its characteristics and condition.

Use of, and public interest in, the ocean is increasing. Conflicts among uses exist, most obviously along increasingly cramped coastal areas. As use of the offshore areas increases, similar conflicts among users will arise. The challenge of the 1980s is to ensure that our private and public institutions are capable of developing, conserving, and protecting the ocean resources and the marine environment.

Chapter III: Marine Fisheries

Characteristics and Status of U.S. Fisheries

U.S. Fishing Effort

Compared to other countries, the United States is a relatively minor fishing nation, ranking sixth in terms of total catch for 1976. In 1976, total world landings were about 73.5 million metric tons (tonnes).[1] (References to metric tons appear as "tonnes" in this chapter conforming with the International System of Units guidelines.) Of this total, Japan harvested about 15 percent (10.6 million tonnes); the U.S.S.R. harvested 14 percent (10.1 million tonnes); and the U.S. share was about 4 percent (3.0 million tonnes).

In terms of value, the major U.S. commercial catches are shrimp, salmon, and tuna. These three groups account for about 50 percent of the total value of the U.S. catch. Other important groups include menhaden, clams, crabs, lobsters, oysters, and scallops. Tuna are caught primarily in international waters; salmon, clams, crabs, and shrimp often come from nearshore waters.

In 1977, foreign operations within United States waters have been distributed among 12 nations: Bulgaria, Canada, Cuba, East Germany (GDR), Italy, Japan, South Korea, Poland, Republic of China (Taiwan), Romania, Spain, and the U.S.S.R. Of this group Japan, U.S.S.R., South Korea, and Poland are the foreign nations with the major fishing activities in United States waters.

The United States imports edible and nonedible fishery products from over 32 countries in every continent of the world. Canada and Japan are the largest North America exporters of edible products to the United States, while Japan supplied 45 percent of total imports from Asia in 1977. Similarly, Canada, Japan, Mexico, and United Kingdom are the major markets for United States fishery products.

Commercial Fishery[2]

The U.S. commercial fishing industry primarily comprises four interrelated activities: harvesting, processing, transporting, and distributing/marketing.

Harvesting

The harvesting segment lands between 1.8 and 2.4 million tonnes of finfish and shellfish annually—or an approximate annual average of 2.14 million tonnes in recent years. Commercial fishery landings, fresh and marine, by domestic fishers at U.S. ports in 1977 were 2.4 million tonnes (5.2 billion pounds) valued dockside at $1.5 billion. U.S. landings have remained essentially stable in recent years despite the increased U.S. fish consumption and change in catch composition.

The 1977 harvest of edible species (roundweight, or live weight as caught) in the United States was about 131.5 million tonnes with a value of $1.4 billion, the largest since 1951. These landings included a record harvest of shrimp (216,208 tonnes) and increased landings of crabs (180,776 tonnes), salmon (152,246 tonnes), flounder (76,931 tonnes), and clams (43,617 tonnes). However, landings of tuna at U.S. ports in 1977 decreased about 30 percent to 156,594 tonnes, down from 220,234 tonnes in 1976. Landings of tuna by U.S. fishers at foreign ports also decreased by about 30 percent during this same period.

Landings at U.S. ports for industrial processing (mainly conversion to animal feed) were 1.04 million tonnes with a value of $111 million in 1977.

Processing[3]

In 1977, the total value of processed edible and industrial fishery products was about $3.9 billion. Edible products increased to $3.5 billion (up 13 percent over 1976), whereas the value of industrial fishery products decreased to $372 million, a decline of 5 percent compared with 1976. This decline is attributed to a reduction in the value of

[1] U.S. Department of Commerce, National Marine Fisheries Service. *Fisheries of the United States 1977*. NMFS Current Fishery Statistics No. 7500, p. 28, April 1978.

[2] Ibid.

[3] Ibid., pp. iv, 22–36, and 69.

canned animal food. The processed products for human consumption in 1977 consisted of:

- canned products—418,186 tonnes,
- fish portions—159,111 tonnes,
- fillets and steaks—68,018 tonnes,
- breaded shrimp—42,698 tonnes, and
- fish sticks—39,458 tonnes.

Industrial products consisted of:

- fishmeal—256,803 tonnes,
- bait and animal food—231,845 tonnes,
- solubles—110,937 tonnes, and
- fish body oil—60,654 tonnes.

In 1976 there were 1,668 plants processing fresh and marine fishery products in the United States that seasonally employed 77,900 people. In the same year, 1,992 wholesale plants seasonally employed 13,900 people. The number of plants engaged in canning, preparation of fillets and steaks, and production of industrial fishery products increased from 520 in 1976 to 533 in 1977. Most of these types of plants are in the Pacific States, and their primary product is canned fish. The South Atlantic and Gulf States have the largest number of plants for processing industrial fish. The largest number of plants for processing fillets and steaks is in the New England States. Several large firms dominate the processing portion of the industry in sharp contrast to domestic harvesting operations. Ninety percent of the U.S. fishing vessels are independent operations and employ fewer than five persons.[4]

About 161,400 persons worked in the harvesting sector of the fishing industry in 1974.[5] This figure includes some persons who were involved on only a part-time basis. An additional 92,000 people (also including some part-time persons) were employed in the processing and wholesaling segments. Thus, the approximate total employment of the commercial and processing segments was 253,000 in 1974. This figure is small relative to total U.S. employment, but significant when compared to employment in some major industries such as: electrical wiring and appliance equipment (227,000), plastics materials and synthetics (224,000), dairy products (202,000), household appliance manufacturing (197,000), coal mining (160,000), nonmetallic minerals (117,000), and metal mining (86,000).[6]

The National Marine Fisheries Service estimates the total value added by commercial fishing activities at $6.7 billion, based on 1973 data. This figure is less than 1 percent of the Gross National Product.[7] Table 3–1 summarizes the commercial industry's recent record.

Regional Impacts

In certain U.S. regions, the importance of the fishing industry relative to other industries is more significant than indicated by the national picture. For example, employment related directly to fisheries in Alaska accounted for 19 percent of the total State employment and 7 percent of the gross State production in 1973.[8] When both the direct and indirect effects of the Alaska fishing industry were considered, they contributed about 23 percent to employment and 12 percent to the gross State product.[9]

Table 3–1.—Commercial fishing industry statistics, 1960–77 [1]

	Commercial landings and imports		
	World commercial catch	U.S. per capita utilization (edible and nonedible)	U.S. per capita consumption (edible only)
	billion pounds	*pounds*	*pounds*
1960	83.2	45.5	10.3
1965	115.5	54.2	10.8
1966	125.2	63.4	10.9
1967	133.4	70.4	10.6
1968	141.1	86.6	11.0
1969	139.1	58.4	11.2
1970	152.8	56.0	11.8
1971	153.7	57.0	11.5
1972	144.6	66.3	12.5
1973	145.7	49.3	12.9
1974	153.9	46.6	12.1
1975	153.7	47.4	12.1
1976	162.0	53.7	13.0
1977	—	48.8	12.8

[1] Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *Fisheries of the United States, 1960, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977.*

[2] NOTE: 1 metric ton (tonne) = 2,204.6 pounds.

[4] U.S. Comptroller General. *The U.S. Fishing Industry—Present Condition and Future of Marine Fisheries*, Washington, D.C., Government Printing Office, 1976, (107 pp.), p. ix.

[5] National Marine Fisheries Service, op. cit. note 1, p. 74.

[6] U.S. Bureau of the Census. *Statistical Abstract of the United States, 1975*. Washington, D.C., Government Printing Office, 1975, pp. 355–356.

[7] Centaur Management Consultants, Inc. *Economic Impacts of the U.S. Commercial Fishing Industry*. NMFS Contract No. 4–36756, Washington, D.C., 1975, p. V.

[8] These figures were derived by the National Marine Fisheries Service. Employment figures were developed from: (a) NMFS, *Fishery Statistics of the United States*, various years. (b) U.S. Bureau of Census, Census of Manufacturers, 1972, Industry Series: Miscellaneous Foods and Kindred Products, MC72(2)–201. (c) U.S. Department of Labor, Bureau of Labor Statistics May 1976, Vol. 22, No. 11.

[9] Values for Gross State Product were based on data from U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, various years. The methodology for computing Gross State Product was based on the procedures described in: J. W. Kendrick and C. M. Joycox, "The Concept and Estimation of Gross State Product." *Southern Economic Journal*, October 1965.

In certain counties, the importance of the fishing industry is more pronounced. Fisheries employment as a percentage of total employment ranged from 3.4 percent in Kenai-Cook Inlet to more than 30 percent in Kodiak. Several counties in Maryland, Texas, Virginia, and Washington also rely heavily on the fishing industry for income and employment.

Domestic and Foreign Market Shares [10]

In the United States, landings have not increased at the same rate as fish consumption. U.S. landings for edible food have stabilized at about 1.3 million tonnes and in 1977, accounted for 39 percent of the total supply of edible fishery products; imports account for 61 percent. Domestic landings for industrial purposes have displayed considerably more variation and currently account for about 73 percent of the total U.S. supply of industrial fishery products.

The reduction in the ability of the U.S. fishing industry to compete in the fishery market is indicated by the relations of imports and domestic landings to total supply. The market share of edible seafood products supplied by domestic commercial fishery landings and imports has undergone significant changes in the past two decades. Imports have represented a steadily expanding portion of supplies of edible seafood products. This increase is due in large part to the lack of many desired fish in U.S. waters.

In 1960, domestic landings contributed 60 percent to total supplies. The domestic share of edible products declined rapidly over the next 13 years and reached a low of 34 percent in 1973. This situation reversed slightly as the domestic share of edible seafood products reached 39 percent in 1977. The growth of imports relative to U.S. commercial landings is partially indicative of the American consumer's preference for high-valued species of foodfish. In 1974, the United States had less than 6 percent of the world's population and consumed 7 percent of all seafood produced (foodfish plus industrial fish). However, the United States consumes a disproportionate share of relatively expensive species of fish. The U.S. market may itself be why some of the products are "high priced," because the United States has the high income to pay top prices. The same applies to Western European nations as well as Japan.

In 1974, U.S. consumption accounted for 91 percent of world lobster landings (both American and spiny lobsters), 41 percent of world tuna landings, and 27 percent of world shrimp landings. Consumption of other high-valued species in the United States included scallops (46 percent), clams (45 percent), and salmon (27 percent).

The U.S. demand for high-value seafood products has resulted in increasing the deficit of the U.S. seafood trade balance (fig. 3–1). In 1960, the deficit was only $285,000; in 1976, it rose to about $2.25 billion.

The supply of industrial fishery products (such as fishmeal and solubles) by domestic and foreign landings followed a different trend. In 1960, the domestic catch provided for almost 62 percent of the supply; however, by 1968, imports increased to 85 percent. A major factor leading to the decline of the domestic share was the rapid growth of the Peruvian anchovy fishery, which was able to compete with and replace United States products. There has also been overfishing of menhaden, which is also a major industrial fish. Beginning in 1969, domestic landings began increasing as the U.S. share of the industrial fish market expanded to 73 percent in 1977. This increase was due to at least two factors: (1) a sharp curtailment of fishmeal supplies from Peru, and (2) rising prices of other livestock feeds, such as soybeans.

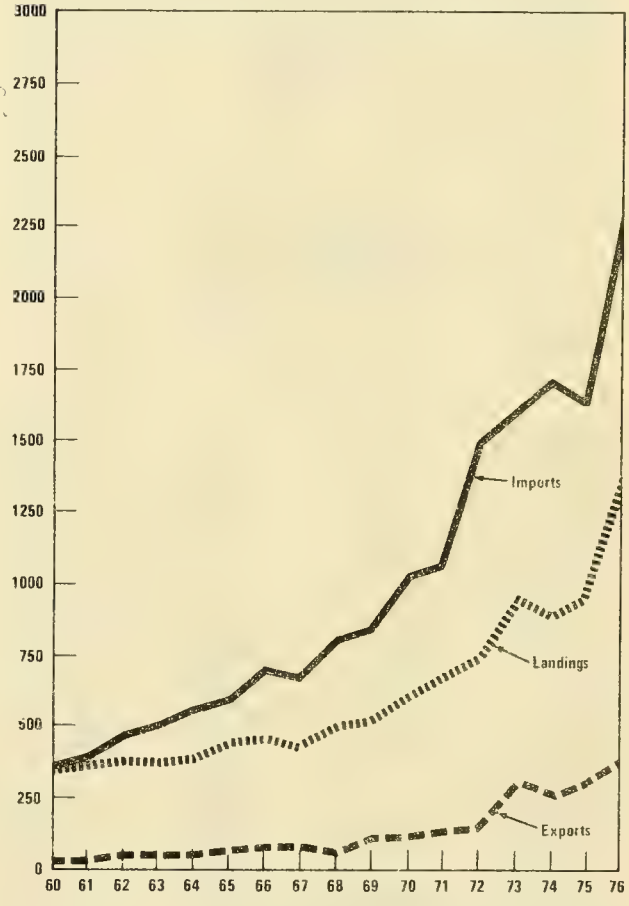


Figure 3–1.—Value of U.S. landings, imports, and exports (millions of dollars). Source: U.S. Department of Commerce, National Marine Fisheries Service, Fisheries of the United States, 1960–76.

[10] National Marine Fisheries Service. *Fisheries of the United States, 1977.* U.S. Department of Commerce, NOAA, pp. 52–53.

Recreational Fishery

The Heritage Conservation and Recreation Service of the Department of the Interior estimates that 207 million days were spent in salt-water recreational fishing in 1975, resulting in expenditures of $3.4 billion. The recreational catch has been about the same size as the commercial food fish catch. In terms of per capita consumption, the recreational catch adds about 3 pounds to the U.S. per capita consumption of edible fish, raising the total to nearly 16 pounds per person in 1977.

Increasing numbers of recreational anglers have resulted in additional competition between recreational and commercial fishing interests for certain species (table 3–2).

Foreign Fishery [11]

Foreign fleets harvest considerable quantities of fish within 200 nautical miles of the U.S. coast. Total foreign harvest, excluding tunas, in the Fishery Conservation Zone between 3 and 200 miles of the U.S. coast was about 1.7 million tonnes in 1977. The record year was in 1971 when foreign fleets harvested about 3.5 million tonnes. The largest catches in 1977 were made by Japan, U.S.S.R., Republic of Korea, Poland, and Canada.

Of major concern to the foreign fleets is the Fishery Conservation and Management Act of 1976 establishing the Fishery Conservation Zone, which extended U.S. fishery management jurisdiction from 12 to 200 nautical miles off the U.S. coast. The Act has resulted in a reduction of foreign catches in both the Atlantic and in the Pacific, with the reduction in the Atlantic proportionately greater than in the Pacific. In recent years, however, foreign catches in U.S. waters had been declining in advance of passage of the 200-mile law. Japan and U.S.S.R. each show declining catch trends since 1973. The number of Japanese and Soviet vessels has tended to decline in some areas, and there is evidence of a slight decline in the catch per vessel for both Japanese and Soviet fishermen.

Figure 3–2 illustrates the change in total foreign

Table 3–2.—Recreational and commercial catch of selected fisheries, 1970 [1]

Fish species	Recreational catch	Commercial catch	Recreational share
	thousand tonnes		*percent*
Jacks	17.12	—	100
Billfishes	6.86	—	100
Red drum	30.16	0.67	98
Sand sea trout	13.83	.57	96
Spotted sea trout	48.26	2.78	95
Bluefish	54.80	3.27	94
Atlantic mackerel	32.08	3.64	90
King mackerel	28.41	3.05	90
Croaker	34.22	3.85	90
Kingfishes	16.41	2.00	89
Striped bass	38.00	5.07	88
Summer flounders	17.83	2.58	87
Groupers	18.59	3.72	83
Bonitos	9.63	4.25	69
Catfishes	32.89	15.76	68
Weakfish	7.11	3.46	67
Spanish mackerel	10.60	5.51	66
Red snapper	7.86	4.15	65
Winter flounders	17.04	11.01	61
Atlantic cod	16.29	24.14	40
Rockfishes	6.24	12.52	33
Chinook salmon	6.88	14.37	32

[1] Source: National Marine Fisheries Service.

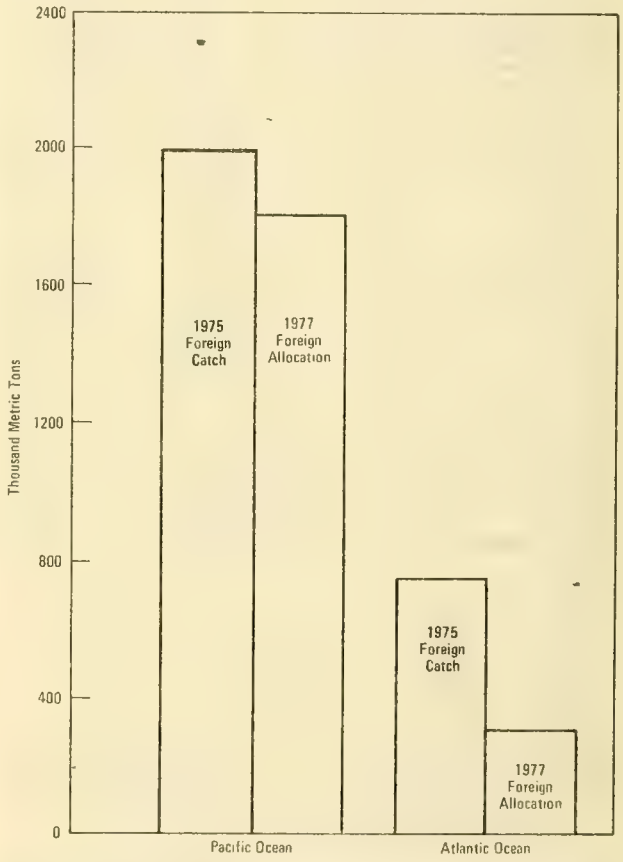


Figure 3–2.—Catch by foreign vessels in 1975; contrasted with 1977 allowable levels of foreign fishing as established by the Fishery Conservation and Management Act. Source: U.S. Department of Commerce, National Marine Fisheries Service, unpublished statistics 1975, and Fishery Statistics of the United States, 1976.

[11] U.S. Department of Commerce, NOAA, NMFS. *Fisheries of the United States, 1977.*

harvests in U.S. waters with implementation of U.S. controls over the 200-mile zone. Figure 3–3 shows the long-term trend in foreign fishing in U.S. waters.

Fishing by foreign nations in the U.S. 200-mile zone is limited to that portion of the optimum yield [12] of any fishery subject to the authority of the United States that will not be harvested by U.S. vessels. Both the optimum yield and the surplus to be made available for foreign fishing are determined by the appropriate Regional Fishery Management Council and approved by the Secretary of Commerce. The Secretary of State, in cooperation with the Secretary of Commerce, allocates the total allowable level of foreign fishing for each fishery among foreign nations on the basis of criteria established under the Fishery Conservation and Management Act. Table 3–3 shows the total allowable levels of foreign fishing under existing management plans for 1977 and 1978, as well as actual foreign catch statistics for 1977.

Most permits issued in 1977 to foreign vessels were awarded to Japan for fishing and support vessels in Alaska waters. Fishing vessels of the Soviet Union received 263 permits, about one-half the Japanese number, and were scattered throughout the Atlantic and Pacific waters. As of January 1978, foreign fishing vessels received 677 permits, as follows: Italy 15, Japan 426, Mexico 10, South Korea 18, Spain 26, and U.S.S.R. 182. The number of approved applications pending permits was 261, as follows: Bulgaria 7, Cuba 16, Italy 5, Japan 43, Poland 22, South Korea 33, Spain 4, Taiwan 8, and U.S.S.R. 123.

The passage of the Fishery Conservation and Management Act and the establishment of the 200-mile management zone had significant consequences for Japan and the Soviet Union. Japan has the second highest per capita consumption of fish and shellfish. Over 50 percent of Japan's total animal protein intake is from this source. The international fishing grounds provide most of the fish and shellfish consumed in Japan, because its coastal and inland fisheries contribute less than 30 percent of its

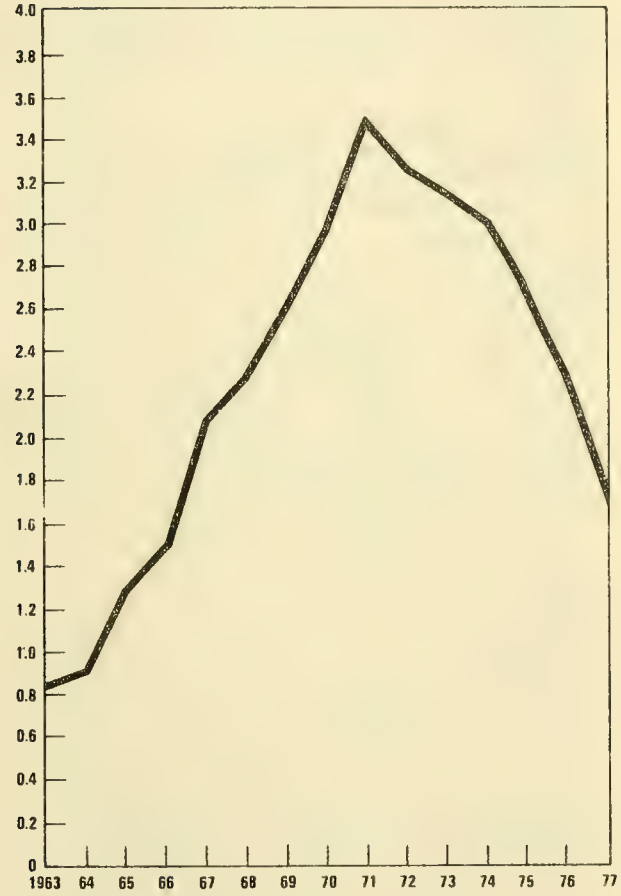


Figure 3–3.—Foreign catch in the 200-mile Fishery Conservation Zone 1963–77 (millions of metric tons). Source: National Marine Fisheries Service.

[12] The optimum yield of a particular fishery is defined by the Act as the amount of fish that (1) will provide the greatest overall benefit to the United States, with particular reference to food production and recreational opportunities, and (2) is prescribed as such on the basis of the biologically maximum sustainable yield from such fishery as modified by any relevant economic, social, or ecological factor.

Table 3–3.—Allowable levels of foreign fishing, by country, 1977 and 1978, and foreign catch in the Fishery Conservation Zone, by Area, 1977 [1]

	1977 Allocation	1977 Catch [2]	1978 Allocation
Atlantic		*thousand tonnes*	
Bulgaria	8.1	4.7	1.5
Canada	17.7	11.4	(a)
Cuba	17.7	1.6	9.7
Federal Republic of Germany	6.5	—	0.9
France	1.2	—	1.5
Italy			
Democratic Republic of Germany	20.2	8.0	—
Japan	32.0	15.0	8.2
Mexico	1.1	—	15.5
Poland	40.0	20.0	5.2
Romania	1.4	0.9	—
Spain	22.9	14.5	18.2
U.S.S.R.	169.1	91.3	91.9
Pacific			
Japan	1,169.4	1,113.3	1,149.4
Korea	81.2	80.2	92.6
Mexico	—	—	51.2
Poland	27.2	20.4	22.9
Taiwan	5.5	1.5	5.8
U.S.S.R.	480.8	291.5	402.1

[1] Source: National Marine Fisheries Service.
[2] Preliminary estimates.
(a) Negotiations in progress.

total fishing catch. In 1976 about 3.5 million tonnes, over 30 percent of its 1976 fishing catch, came from waters within 200 miles of foreign countries. For several years, Japanese fishing and trading companies have invested in Alaska fish processing plants anticipating the day when United States law would restrict fishing in the Gulf of Alaska and the Eastern Bering Sea.

U.S. Overseas Fishing

Fishery agreements concerning U.S. access to foreign zones for shrimp and tuna fishing are of primary importance to the United States. The U.S. catch of shrimp taken from the Mexican Economic Zone and Brazilian Economic Zone is as follows: in 1976, 95,290 tonnes of shrimp were taken from the Gulf of Mexico, 2,390 tonnes from Mexican waters, and 16,948 tonnes from Brazilian waters.

About 400,000 tonnes of tuna worth $250 million are caught annually in the waters stretching from Southern California to Chile. The U.S. tuna fleet takes about 75 percent of the total catch in this area and has the largest and most efficient vessels. The United States consumes 90 percent of the total tuna catch in the area.

The Fishery Conservation and Management Act of 1976 does not include tuna as a species to be managed by the United States. All the coastal nations of the prime tuna-fishing area claim jurisdiction over the tuna within 200 miles of their coasts. The U.S. fishing zone law expresses the principle that tuna should be managed internationally. Differences in jurisdictional concepts concerning tuna have existed for nearly 30 years between the United States and other countries, especially Ecuador and Peru, resulting in the occasional seizure of United States ships. The jurisdictional claims concerning tuna could be a source of disagreement between the United States and nearly every country in the Eastern Pacific claiming a 200-mile zone, especially Costa Rica, Mexico, and Panama.

Currently, the InterAmerican Tropical Tuna Commission (IATTC) regulates yellowfin tuna in the Commission Yellowfin Regulatory Area from California to Peru. Regulations include limits on season openings and closings, closed season allowances, and incidental catch allowances. Enforcement of IATTC regulations is carried out by member nations against vessels of their respective flags in the same way that U.S.-flag tuna vessels are subjected to procedures and penalties available under the Tuna Convention Act of 1950. Future management systems for tuna may combine the U.S. concepts of international management with individual national jurisdictional claims.

The vast majority of Atlantic tuna are caught off the coast of Africa in the eastern tropical Atlantic. The U.S. fishery for Atlantic tuna is subject to the provisions of the Atlantic Tuna Convention Act of 1975, and regulated under the International Commission for Conservation of Atlantic Tuna. Most tuna caught in these waters are yellowfin, skipjack, or tropical tunas. Yellowfin and skipjack tunas are also caught in the western Atlantic. The total catch of yellowfin and skipjack tuna increased from 20,700 tonnes in 1970 to 21,400 tonnes in 1975. The International Commission for Conservation of Atlantic Tuna has established conservation measures designed to enhance the status of the Atlantic tuna resources.

Marine Mammals

The National Marine Fisheries Service is responsible for the determination of international policy proposals concerning whales and other marine mammals except manatees, polar bears, sea otters, and walrus, which are under the jurisdiction of the Department of the Interior under terms of the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. An exchange of views is facilitated by interagency committees, whose membership consists of representatives from the Departments of Commerce, the Interior, and State, the Council on Environmental Quality, the Marine Mammal Commission, and members of special interest groups, as observers. The passage of the Fishery Conservation and Management Act extends the U.S. jurisdiction over whales and other marine mammals to 200 miles. The Marine Mammal Protection Act prohibits the taking of whales within the U.S. jurisdictional waters and therefore prohibits whaling in the near North Pacific Ocean, including Hawaiian waters, by Japan and the Soviet Union, the two principal remaining commercial whaling nations in the world.

Fish Imports

Historically, the United States has been a net importer of fishery products. In 1977, the United States imported over 1 millon tonnes of edible fishery products valued at $2.1 billion and exported 148,976 tonnes of edible domestic fishery products valued at $473.4 million. In the same year, the United

States imported nonedible fishery products valued at $543 million and exported nonedible fishery products worth $47 million.[13]

In 1977, the major U.S. imports of fishery products were cod, haddock, American lobsters, sardines, scallops, shrimp, spiny lobster, and tuna. Imports of fishery products from these eight groups accounted for nearly 60 percent of the total U.S. imports of fishery products.

Factors of Demand

While population has been increasing in the United States at about 1 percent per year, the aggregate fish consumption has been increasing about 3 percent per year. The per capita consumption of fish has involved an increase in the consumption of fresh and frozen seafood. Between 1960 and 1976, the per capita consumption of fish increased from 10.3 to a record 13.0 pounds. With the estimated recreational catch added to consumption, per capita consumption ranges from 13.3 to nearly 16 pounds for the same period.

The U.S. per capita consumption of fish is relatively small when compared to the consumption of meat and poultry (table 3–4). The consumer price index for fish increased from 85 to 216 between 1960 and 1976. While the consumer price indices for meat and poultry also increased during this period, the gains were not as substantial (table 3–5).

Factors affecting the relative strength of the fish market in this country include increased public interest in diets and nutrition, which finds fish an excellent source of low-fat protein, and expansion of fast-food outlets selling fish fillets.

Fish in the Food Budget

The relative importance of fish compared to other items in the food budget has changed gradually in the last 20 years. Between 1960 and 1974, food expenditures as a share of disposable income declined from 19.6 percent to 15.8 percent. Most of the commodities in the food budget followed a similar trend, but fish did not. Fish prices went up more than the amounts purchased, and, as a result, expenditures on fish items as a percentage of disposable income increased from 0.48 percent to 0.78 percent. In dollar terms, expenditures at the retail level increased from $1.7 to $7.4 billion.

Composition of expenditures on major commodities has shifted also. Expenditures on meat have fluctuated between 27 and 31 percent; outlays for poultry ranged from 3 to 5 percent. In 1974, poultry outlays were slightly more than 3 percent of the food budget.

Expenditures on fish as a percentage of the food budget, however, increased from 2.5 percent in 1960 to 4.9 percent in 1974. During the years 1960–74, outlays for fish quadrupled, while total food expenditures doubled. The increase in the outlays for fish has partly been the result of increased sales of frozen seafood products. Frozen seafood sales were 14 percent of the total value of all frozen foods sold in 1964; by 1974, the value of frozen seafood sales had increased to about 20 percent of the total value. The primary reasons for the increase in sales of frozen seafoods appear to be due to the ease of preparation and the popularity of fish portions in fast-food outlets.

Table 3–4.—Food consumption of meat, poultry, and fish in terms of actual per capita consumption [1]

	Meat pounds	Poultry pounds	Fish [2] pounds	Total pounds
1959	146.6	35.6	13.7	195.9
1960	146.9	34.4	13.2	194.5
1961	145.4	37.7	13.7	196.8
1962	147.1	37.3	13.6	198.0
1963	152.0	38.0	13.7	203.7
1964	155.7	39.0	13.5	208.2
1965	148.3	41.3	13.8	203.4
1966	151.4	43.8	13.9	209.1
1967	158.3	45.5	13.6	217.4
1968	162.4	45.0	14.0	221.4
1969	161.4	47.1	14.2	222.7
1970	164.6	48.9	14.8	228.3
1971	170.0	49.2	14.5	233.7
1972	166.5	51.4	15.5	233.4
1973	154.7	49.6	15.9	220.2
1974	165.2	50.3	15.1	230.6
1975	158.1	49.3	15.1	222.5

[1] Source: *Agricultural Statistics, 1976.*
[2] Includes gamefish.

Table 3–5.—Consumer Price Index for meat, poultry, and fish, 1960–76 [1]

Year	Fish	Meat	Poultry
1960	85	87.2	106.9
1965	90.8	93.9	101.2
1968	101.6	102.3	103.1
1969	107.2	111.4	109
1970	118.0	117.6	108.4
1971	130.2	116.7	109
1972	141.9	129.2	110.4
1973	162.8	161.1	154.8
1974	185.2	173.1	152.0
1975	195.7	177.9	162.4
1976	216.1	178.2	155.7

[1] Source: U.S. Department of Commerce, Bureau of the Census. *Statistical Abstract of the United States, 1976.* p. 439.

[13] U.S. Department of Commerce, NOAA, NMFS, *Fisheries of the United States, 1977.* April 1978.

Fish Prices [14]

Between 1970 and 1976, the average sale price of fish from boats increased from $0.1247 per pound to $0.2520 per pound—a 103-percent increase. The major portion of the increase is in the price of shellfish—$0.32 per pound to $0.76 per pound. Shellfish contribute about 50 percent to the total value of all fish and shellfish.

Status of Representative Stocks

The following discussion of the condition of major U.S. fisheries is taken from the 1976 report of the General Accounting Office entitled, *The U.S. Fishing Industry—Present Condition and Future of Marine Fisheries*. Some fishery experts question some of the data and findings of the report, yet the description of the various stocks is generally considered to be sound.

Clams

Landings of hard, soft, surf, and other clams in 1975 were 111 million pounds valued at a record $41 million. Almost all the U.S. clam production comes from New England, Middle Atlantic, and Chesapeake Bay States. Lack of management and pollution have been problems affecting clam resource availability.

In 1975 NMFS estimated the maximum sustainable yield of surf clams to be about 70 million pounds. Landings during 1973–75 exceeded this amount. The highest landings, 96 million pounds, were made in 1974.

A maximum sustainable yield figure has not been established for hard clams; however, a State fishery official believes that the resource is being harvested at sustainable levels. More resource assessment is needed and would aid in management of the fishery.

Maine, which accounted for about 75 percent of the soft clams in 1975, has no established maximum yield figure for the resource. A State official believes that the resource is being fished at about the sustainable level possible with current harvesting gear.

Pollution is the greatest threat to hard and soft clams. In the two leading hard clam producing States, about 25 percent of the clam flats are closed, because of pollution. About 21 percent of the flats of the leading soft clam producing State are closed because of bacterial pollution. Pacific coast clam production is small; however, the coasts of Alaska and Washington have significant and underutilized clam resources.

Crabs

Commercially important crab fisheries include blue crabs of the Atlantic and Gulf coasts; king and tanner crabs, which are caught exclusively off Alaska shores; and dungeness crab, which is caught off nearly the entire Pacific coast.

Landings of hard blue crabs were 142.5 million pounds in 1974. The Chesapeake Bay and Gulf of Mexico States were the leading producing areas.

The supply of blue crabs is not stable. There are insufficient research and information to determine whether the fishery can be maintained through conservation at any particular level of abundance or whether the yield is determined solely by natural factors. It is known, however, that the resource is environmentally sensitive and pollution can cause fluctuations in the resource. Fishery biologists believe that resource assessment data for the Gulf are insufficient to evaluate the status of stocks.

The Pacific crab catch in 1975 was 162.2 million pounds, worth $61.5 million. The 1975 catch was 15.5 million pounds less than the 1974 catch, but the value was $734,000 greater than the 1974 value. The 1975 catch of king crab—100 million pounds—was the highest since 1968. The rise in the king crab catch since 1969 indicates that the resource is recovering from overfishing of past years. The tanner crab fishery has developed rapidly over the period 1968–75; landings increased from 3.2 million pounds in 1968 to the record catch in 1974 of 64.1 million pounds before dropping back to 46.2 million pounds in 1975. The dungeness crab catch in 1975 was 16 million pounds, valued at $10.3 million. The 1975 catch, along with the 1974 catch of 16 million pounds, indicates that the declining dungeness crab catch has stabilized since 1970.

According to NMFS, the king and dungeness crabs are currently under intensive use and the tanner crabs are underused.

Atlantic Groundfish

Major Atlantic species of commercial groundfish include butterfish, cod, croaker, flounder, haddock, hakes, pollock, ocean perch, and scup. Heavy fishing pressure by both U.S. and foreign fishermen during the 1960s and early 1970s resulted in major declines in groundfish abundance. Off the New England coast the resource is estimated to have declined 45 percent between 1963 and 1972.

Foreign fleets have caused or contributed to the depletion of species, such as haddock and yellowtail flounder stocks, and reduced the abundance of stocks of cod, ocean perch, and lower value species, such as red hake and silver hake. Preliminary data show that foreign fleets caught 363.8 million pounds,

[14] The exvessel price discussion is based on data presented in *Fisheries of the United States, 1970, 1971, 1972, 1973, 1974, 1975, and 1976*. National Marine Fisheries Service, NOAA, U.S. Department of Commerce.

or 60 percent, of the 602.3 million pounds of major Atlantic groundfish caught in 1974.

Pacific Groundfish

The major Pacific coast groundfish species of commercial interest or potential commercial interest include cod, flounder, hakes, lingcod, ocean perch, pollock, rockfishes, and sablefishes. The Fisheries Service estimated that stocks of Alaska pollock (Bering Sea stock), yellowfin sole, and yellowtail flounder, and some stocks of Pacific ocean perch and rockfishes are depleted. Also, some stocks of sablefish and Pacific hake and other stocks of flounder are intensely fished.

Foreign fishing has targeted on Pacific hake, Pacific ocean perch, Alaska pollock, sablefish, and other groundfish in the Bering Sea and Alaska. U.S. fishermen land very little Pacific hake and almost no Alaska pollock. During 1974 the Pacific groundfish harvest was 5.75 billion pounds, 97 percent of which was caught by foreign fleets.

Gulf of Mexico Groundfish

The commercially important groundfish species in the Gulf of Mexico are snappers and groupers. The trend in U.S. landings of snapper/grouper has been declining since 1965. Snapper landings have declined from 15.9 million pounds in 1965, to 11 million pounds in 1973. Grouper landings have shown the same trend, declining from 9.9 million pounds in 1954 to 6.6 million pounds in 1973. In addition, recreational fishing for snapper/grouper yielded an estimated 82.7 million pounds in 1970. Also, in 1971–75, Cuban vessels fishing off Florida harvested from 3.5 to 5 million pounds per year.

Little information is available on the snapper/grouper stocks, and no estimates of the maximum sustainable figure have been made. The steady decline in commercial catch indicates resource problems related to increased fishing pressure by commercial, recreational, and foreign flag fishermen. The incidental catch of snapper by vessels trawling for shrimp also may affect the declining fishery by reducing the abundance of young snappers.

Halibut

According to NMFS, the halibut stocks in the northeast Pacific and Gulf of Alaska are depleted and the stock in the Bering Sea is in imminent danger of depletion. However, the International Pacific Halibut Commission (IPHC) officials have stated that the halibut stock in the Bering Sea is also depleted and actually in poorer condition than the Gulf of Alaska stock. The U.S. landings of halibut have declined from a high of about 60.7 million pounds in 1954 to about 18.5 million pounds in 1974. Industry, government, and IPHC officials attribute the decline in U.S. halibut landings to overfishing and to the incidental catch made by the Japanese and Soviet vessels trawling for target species such as pollock, and ocean perch and sablefish. The 1975 season indicated some improvement in the halibut stock, i.e., the 25-million-pound quota established by IPHC for the northeast Pacific and the Gulf of Alaska was reached, the catch per unit of effort increased, and the abundance of juveniles in the Bering Sea increased.

Herring

Sea herring stocks in the Atlantic are depleted. During 1975 the total catch in the Atlantic off U.S. waters was 360 million pounds, of which U.S. landings were 80 million pounds, or about 22 percent of the total catch.

In 1975, the U.S. herring catch in the Pacific, according to preliminary statistics, was 40 million pounds, valued at $2.9 million. A 1972 NMFS report stated that the catch of Gulf of Alaska herring was considerably less than the maximum sustainable yield of 500 million pounds. Estimates of herring population off the California coast indicate that the resource may be underused.

American Lobster

Landings of American lobsters in 1975 were 29 million pounds valued at $49.1 million. Inshore landings have generally declined since 1960, while offshore landings peaked in 1970.

The American lobster is seriously overfished, resulting in depletion throughout its inshore range (within the former 12-mile fisheries zone). A study in one State concluded that nearly all available legal-sized lobsters are caught each year. Research has indicated that current mortality rates are too high and minimum sizes are too low in all areas.

While stock assessments have not been sufficiently complete to establish a maximum sustainable yield for the inshore fishery, NMFS officials believe that the inshore maximum sustainable yield is conservatively estimated to be between 25 and 30 million pounds. As a result of the depleted state of the stock, landings in the inshore area have declined despite a substantial increase in effort. Biologists estimate that the maximum sustainable yield for the inshore fishery from Maine to North Carolina could be taken with about 1 million pots. In 1975 preliminary data indicate that there were 2 million pots—or double the capacity needed.

Although a precise yield figure cannot be established for the offshore stocks because of inadequate catch statistics, fishery officials believe that catches have been within the fishery's sustainable limits.

Spiny Lobster

Spiny lobsters are found in the Atlantic from North Carolina to Brazil and in the Pacific from

Southern California to South America. The spiny lobster is subject to intensive fishing. Total landings in 1975 were 7.7 million pounds, of which landings in the State of Florida were 7.5 million pounds. Of the total Florida landings, about 5.5 million pounds were harvested from domestic waters and 2 million pounds from foreign waters. The trend in Florida landings from 1953 to 1973 was generally upward. The increases were largely due to the harvest landed from the Bahamian fishery, which was closed to U.S. fishers as of August 1, 1975, by the Bahamian Government.

Menhaden

The predominant species are the Atlantic and Gulf of Mexico menhaden. The Atlantic menhaden has been fully exploited and will not sustain past levels of fishing effort. Annual landings in the Atlantic have shown a classic response to a developing fishery. Landings increased fairly steadily to a peak in 1956 and then declined as the harvesting rate exceeded the growth rate of the menhaden population. The population and landings have recovered significantly since the low catch of 390 million pounds in 1969. Landings in 1975 were 605.7 million pounds.

NMFS officials believe that fishing effort is about 25 percent greater than that required to harvest the estimated maximum sustainable yield and great enough to damage the resource and impair its ability to sustain itself.

The record catch of Gulf menhaden in 1971 was over 1.6 billion pounds; but landings have since declined and no trend is indicated. In 1975 the catch was 1.2 billion pounds.

NMFS has concluded from completed studies and analyses that the Gulf menhaden resource is healthy and producing an annual catch that is considered sustainable. The latest yield estimate for the Gulf menhaden is 1.09 billion pounds. Using an 80 percent statistical confidence level, the upper maximum yield limit is estimated at 1.18 billion pounds.

Oysters

Commercially important oysters are the eastern oyster, which is harvested from Massachusetts to Texas, principally in the Chesapeake Bay and the Gulf of Mexico; and the Pacific and western oysters harvested in U.S. waters off the Pacific coast from California to Washington.

Total oyster landings have steadily declined. Atlantic landings averaged about 50 million pounds per year in the 1950s, but declined to an average of 28 million pounds per year in the 1960s and 1970s. In the Gulf, landings during 1975 were 19.6 million pounds, which approximate the annual landings of the 1960s. On the Pacific coast, landings have steadily declined from the 12.3 million pounds in 1959 to about 3.7 million pounds in 1975. Factors that affect oyster production include:

- Natural changes to the environment, such as floods, which affect the salinity of the water (a critical factor in oyster survival) and diseases.
- Bacterial and industrial pollution, which, as an example, has resulted in the closure of 33,000 acres of bottom suitable for oyster production in Louisiana.
- Availability of seed oysters.
- Obstacles to increased investment in private beds, such as the high risk of loss due to floods, pollution, disease, and predators.

Salmon

The five species that make up the Pacific coast salmon fishery are the chinook, chum, coho, pink, and sockeye salmon. In 1975, landings of Pacific salmon were 201.6 million pounds worth $116.3 million. The pink and chum salmon accounted for about 45 percent of the 1975 commercial landings. Sockeye salmon accounted for about 26 percent, but is considered the most valuable for canning purposes. The chinook and coho salmon are the least abundant of the species, but are the object of important commercial troll and sport fisheries.

According to NMFS, salmon resources are, for all practical purposes, fully used, but some stocks are depleted. U.S. landings of Pacific salmon in 1975 were 76.8 million pounds below the 1970–74 5-year average of 278.4 million pounds. The causes for decline vary from one area to another; however, major reasons for the decline are overfishing, inadequate management, habitat degradation, adverse climatic conditions, and foreign fishing. Alaska and Washington have implemented limited entry systems in the salmon fishery.

Scallops

Sea, bay, and calico scallops, commercially harvested by the United States, declined from 22.8 million pounds in 1965 to 13 million pounds in 1975. NMFS considers the Atlantic sea scallop, the most commercially important scallop in the United States, to be at a relatively low level of abundance. NMFS officials believe that the Georges Bank resource is being overfished, primarily by Canadian fishers. They also believe that many scallops are harvested at sizes much smaller than the size producing the maximum meat yield. The status of the Alaska sea scallop is not clear, but it appears that catches may not increase significantly above present landings of under 2 million pounds per year.

Bay scallop landings have generally been 1 to 2 million pounds annually; substantial increases are not expected. Calico scallops are underused.

Shrimp

Shrimp resources of the United States are distributed along the Atlantic, Gulf of Mexico, and Pacific coasts. Landings in 1975 were 343.6 million pounds and were valued at $226.2 million.

In 1975 the Gulf States accounted for 49 percent of the total U.S. landings and 79 percent of the value. Historically, the Gulf has provided over 76 percent of the landed value of U.S. shrimp. NMFS officials have varying opinions on the status of the Gulf shrimp stock. Some officials believe that the data are insufficient for estimates of the biomass or for establishing a maximum sustainable yield figure; others believe that the fishery appears to be operating at or near the maximum sustainable yield. Existing harvesting capability in the Gulf appears to exceed that needed to harvest the available resources. Shrimp landings over the last 11 years or so have been essentially constant. The catch per unit of effort has decreased, which indicates more intensive effort for the relatively constant level of the shrimp biomass.

The 1975 shrimp catch in the Pacific was 136.9 million pounds valued at $14.5 million. In 1975, for the fourth consecutive year, Alaska led the Nation in volume with 98.3 million pounds.

The principal shrimp fisheries in the Atlantic are located off the coasts of Maine, New Hampshire, Massachusetts, North Carolina, South Carolina, Georgia, and Florida. The combined landings of northern and southern shrimp in 1975 were about 36.6 million pounds valued at $33.4 million.

Shrimp stocks in the northern Atlantic are depleted. Total landings have decreased, and there are indications of decreases in the catch per unit of effort and size of shrimp landed. Stock depletion of the northern shrimp is directly related to an intense buildup of fishing effort. The fishery had 89 vessels in 1967 and 400 in 1972. The increase in fishing effort and the decline in stocks indicate excess harvesting capacity. Some biologists believe that environmental factors have also contributed to the decline of the northern shrimp.

The southern Atlantic shrimp fishery appears to be operating at or near the maximum yield under present fishing practices. The catch per unit of effort in the South Atlantic is quite low owing to the large number of vessels in the fishery.

The South Atlantic and Gulf have some shrimp species, including royal red shrimp, that are underused. Research, however, has not shown that sufficient quantities are available for commercial development. On the Pacific coasts, some shrimp resources in Alaska waters are underused.

Tuna

The commercially important species of tuna include albacore, bigeye, bluefin, skipjack, and yellowfin. Tuna live throughout the tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans.

As early as 1971, NMFS officials considered stocks of the temperate and tropical species in the traditional grounds to be caught at nearly their potential maximum. The 5-year trend of U.S. tuna landings during 1970–74 has been upward. The 1975 catch was a record 568.2 million pounds, of which about two-thirds were landed in the continental United States and Hawaii and one-third in Puerto Rico. The increased domestic tuna catch in 1970–75 resulted, in part, from a greatly intensified fishing effort by U.S. seiners.

Future sustained catch increases of albacore and yellowfin tunas are not expected in the eastern Pacific traditional fishery. In addition, U.S. fishers are having increased difficulties in retaining access to traditional tuna fishing grounds in the eastern Pacific, because of the growing trend toward extended national jurisdiction over fishing resources.

Federal Fisheries Establishment

With the goal of maintaining an adequate supply of fish and fish products for the American consumer and marine anglers and the commitment of protecting marine resources, the Federal Government has become involved in fisheries at all levels. This involvement includes basic research (understanding the biology of fish, their roles in the aquatic ecosystem and their population dynamics); management and conservation (establishing regulations and programs to assure that stocks are not depleted and that habitats are protected), financial and technical assistance to strengthen the fishing industry and foster recreational fishing, and pollution abatement and habitat protection measures.

As early as 1871, the Congress became aware that marine fish stocks could be depleted by man's actions. The Office of the Commissioner of Fish and Fisheries was established to study the problem and to determine how it could be alleviated. Today, increased fishing activity combined with more efficient gear and harvesting techniques has threatened many stocks in waters within the U.S. jurisdiction.

While neither fish nor their use has changed significantly during the past 100 years—they are still primarily a food item—they have become more than a source of protein. Fish are an international commodity, and fishing is both a recreational activity and the resource base of an industry. Commercial fishing activities and their supporting industries contribute an estimated $7 billion to the U.S. economy.[15]

[15] U.S. Department of Commerce, NOAA, NMFS. *Fisheries Development—Wave of the Future.* Washington, D.C. Unpublished.

The extension by coastal nations of their national jurisdiction to 200 nautical miles, coupled with the fears of a pending food shortage in many areas of the globe, has made the harvesting of fish an international concern, leading to a "cod war" and a "tuna war," for example.

It is for this reason that Federal involvement in fishery research and management and the promotion of the domestic fishing industry has increased over the years. The Federal Government's involvement in fisheries can be grouped into three categories:

- Fishery research and information
- Fishery management and conservation
- Use of fishery resources and development of the domestic fishing industry

Fisheries Research and Information

The Federal Government conducts and sponsors a variety of basic research programs designed to add to an understanding of the biological and ecological principles that underlie fish and fisheries.

The National Marine Fisheries Service (NMFS) of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) is the principal group concerned with fisheries and fishing in the marine environment. Complementing this activity, the U.S. Fish and Wildlife Service of the Department of the Interior has primary responsibility for freshwater species.

The Fish and Wildlife Service's Coastal and Anadromous Fisheries Program operates several fishery laboratories that perform basic biological research. The Atlantic Salmon Investigations Program, based in Orono, Maine, is involved in the restoration of Atlantic salmon to its native habitats. This program has demonstrated considerable success in the Connecticut River.

Both the Fish and Wildlife Service's National Fisheries Center in Kearneysville, W. Va., and the NMFS National Fisheries Research Laboratory in Seattle, Wash., do research on fish diseases. The Seattle facility is also studying migration patterns among salmon.

The Tunison Laboratory of Fish Nutrition at Cortland, N. Y., has been investigating the dietary needs of Atlantic salmon.

NMFS is responsible for monitoring and assessing fish stocks in the marine environment with special attention being paid to threatened and endangered species. Its Marine Monitoring, Assessment, and Prediction system (MARMAP) uses a variety of techniques to obtain information on the composition, distribution, abundance, and availability of living marine resources. These results are often supplemented by assessment programs of the coastal States, some supported by Federal grants.

The key components of the Federal marine fisheries research effort are the NMFS regional centers. These centers and associated laboratories, together with their academic counterparts in universities, constitute the fishery "establishment" in terms of scientific research, stock assessments, and environmental evaluations.

These centers, together with all NOAA laboratories, were evaluated in 1975 and 1976 by a team of peers under the sponsorship of the Ocean Sciences Board of the National Academy of Sciences. The teams found the NMFS laboratories to be performing sound scientific work; some of the installations were judged to be excellent, whereas a few were found to be lacking in a number of areas.[16]

The laboratories, their 1975 budgets, and comments from the National Academy of Sciences evaluation follow:

1. Northeast Fisheries Center, Woods Hole, Mass., and Narragansett, R.I., $2,731,000. Have a "prominent international reputation in fishery science."
2. Middle Atlantic Coastal Fisheries Center, Sandy Hook, N.J., Oxford, Md., and Milford, Conn., $3,534,000. Concentrate on ecosystem, resource assessment, experimental biological and pathobiological research; researchers have some problems with the relative isolation of the installations.
3. Atlantic Estuarine Fisheries Center, Beaufort, N.C., $1,167,000. Concentrates on regional estuarine and fishery problems, particularly menhaden.
4. Southeast Fisheries Center, Miami, Fla., Bay St. Louis and Pascagoula, Miss., $2,119,000. Perform investigations of fisheries under pressure from high catch levels, as well as environmental research; found to have a not very high level of professionalism, including a low proportion of Ph. D. researchers.
5. Gulf Coastal Fisheries Center (now part of the Southeast Center), Galveston and Port Aransas, Tex., and Panama City, Fla., $1,345,000. The Galveston laboratory works on commercial fishing problems, the other two on sport fishing. Some programs have low scientific productivity; shrimp culture work of high quality.
6. Southwest Fisheries Center, La Jolla, Calif., and Honolulu, Hawaii, $3,938,000. The coastal division found to be a "center of excellence" with high scientific productivity; the newer ocean divi-

[16] Ocean Sciences Board, National Academy of Sciences. *The Quality of NOAA's Ocean Research and Development Program—An Evaluation.* Washington, D.C., National Academy of Sciences, 1977, 144 pp.

sion, concentrating on tuna and porpoise problems, found to be "promising" in quality.

7. Northwest Fisheries Center, Seattle, Wash., and Auke Bay and Kodiak, Alaska, $7,741,000. Found to be doing satisfactory work in a variety of fields, including aquaculture disease, dredge disposal, and entrainment and impact of dams and other obstacles.

In addition, NMFS operates an Atlantic Environmental Group in Narragansett, R.I., (budget $249,000), a Pacific Environmental Group in Monterey, Calif., ($297,000), and the National Systematics Laboratory in Washington, D. C.

NMFS and the Fish and Wildlife Service jointly monitor the abundance and distribution of fish and shellfish that are important to domestic marine commercial and recreational fishing interests. The two fisheries services cooperate in the regulation of anadromous species, such as salmon, which spawn upstream and live the rest of their lives in the marine environment.

Various Federal agencies (National Marine Fisheries Service, Fish and Wildlife Service, and the Corps of Engineers) often cooperate with each other and various State agencies in the conduct of fish husbandry research on salmon and other species. This research is aimed at developing improved rearing techniques and diets for fish hatched and grown there.

As man-induced disruptions of the marine environment often contribute to the threatened status of fish stocks and species, special programs were established to examine the effects of these disruptions on fish and their habitats. The Environmental Protection Agency (EPA) was created in order to prevent, control, and abate environmental pollution. Through the issuance of permits, EPA prescribes conditions under which pollutants may be discharged into marine waters. EPA uses its permit authorities to protect marine fishery resources and fishery habitats. Together with the two fishery services, EPA conducts marine ecological analyses to assess the effects of chemical and sewage discharge in the ocean as well as the effects of oil and gas development, deep ocean mining, and other marine industries. EPA also works with the U.S. Army Corps of Engineers to identify sites where dredged material may be dumped, and to protect the marine environment through regulation of such dumping.

The National Science Foundation (NSF) also participates in environmental analyses. Although it does not perform its own research, NSF promotes, via grants to academic institutions, basic research in marine and oceanographic affairs. In this indirect fashion, NSF-sponsored research focuses on the impacts of ocean dumping on fish habitats.

Energy facilities are sited where there is access to large supplies of cooling water. The hot water discharged back into the aquatic environment could increase ambient temperatures and affect fisheries. To determine the biological effects of the hot water effluent, the Department of Energy and the Tennessee Valley Authority (TVA) perform biothermal research. Application of this research could become important with offshore siting of energy facilities such as the floating nuclear powerplants that have been proposed off New Jersey's coast. Since EPA has the general mandate to assure water quality, it is involved in this research as well. The other concern for fisheries is the effect of radioactivity on the marine ecosystem.

The National Sea Grant Program, administered by NOAA, contributes to the development of information on fisheries by offering grant money for the establishment and promotion of marine science curricula and research projects at public and private colleges and universities, marine institutes, and marine laboratories. Current funding supports aquaculture research, studies on the environmental and ecological effects of ocean dumping on marine fisheries, and education and training programs in the marine sciences.

The National Aeronautics and Space Administration (NASA) has a technological utilization program that promotes the application of its technological developments to industrial and public needs. NASA has developed remote sensing instruments that could be used to track fish movements and to select promising fishing areas.

The National Environmental Satellite Service, a component of NOAA, monitors and measures the Earth's environment and supplies data needed for weather forecasting. In developing the capability to measure sea-surface temperatures, these data have been correlated with some fish migrations. This information can be used to pinpoint potentially good fishing grounds, and may also be helpful in assessing fishery stocks, a first step in the establishment of fishery management plans.

Similarly, the Navy's research has spinoff applications for fishery research and management. For example, underwater acoustic sensors that were developed for submarine detection have already been used by NOAA to study the migratory movements of large marine mammals and schools of fish. In addition, the Navy's oceanographic activities include research into the geological, chemical, and biological nature of the oceans as well as ocean engineering programs.

Other Navy research projects that have been applied to the needs of the fishing industry include: communications and navigation equipment, buoyancy materials, corrosion-free rigging, and sensing equipment to locate lost gear.

The Federal Government supports research on the development of aquaculture in NOAA, the Department of Agriculture, the Fish and Wildlife Service, and the National Science Foundation. The Food

and Agriculture Act of 1977 [17] designated the Department of Agriculture as the lead agency for the development of aquaculture, which was identified as primarily a farming rather than a fishing activity. The Department of Agriculture plans to develop the scientific, technological, and marketing base for the culture of freshwater species such as catfish and trout, among others.

In recent years, the development of more extensive ecological baseline information in offshore areas where Outer Continental Shelf (OCS) oil and gas operations are to take place has created another source of information on factors affecting fishing. In some areas, assessments of the impact on fisheries from OCS operations have been a primary focus of offshore investigations by the Bureau of Land Management of the Interior Department. (See chapter VI.)

Several Federal advisory bodies have varying degrees of input into fishery research, management, and development efforts. The group whose activities are entirely devoted to fishery affairs is the Marine Fisheries Advisory Committee. The Secretary of Commerce established this group in 1971 to advise the Secretary on the Department's fishery responsibilities and the effectiveness of their programs. In the past, it has shown interest in developing a National Fisheries Plan and in the revitalization of the domestic commercial fishing industry.

The Congress established the National Advisory Committee on Oceans and Atmosphere (NACOA) in 1971. The group, whose members are Presidentially appointed, was responsible for recommending the development of a national marine fishery plan and for reviewing the Government's marine and ocean programs, including fisheries.

Another advisory group that indirectly influences fishery policy is the Marine Mammal Commission. The Presidentially appointed three-person Commission was established by Title II of the Marine Mammal Protection Act of 1972 to study marine mammal issues and make recommendations.

Another advisory group with a role in marine fishery affairs is the National Academy of Sciences and Engineering. This body studies and analyzes a broad range of marine issues. Its reports are of a technical nature, but also cover related socioeconomic issues.

Fishery Management and Conservation

The Fishery Conservation and Management Act of 1976 established for the first time a comprehensive program to manage fisheries in the U.S. fishery conservation zone, which extends from 3 to 200 nautical miles. The Act authorizes institutions, procedures, and programs designed to manage and conserve U.S. fishery resources. The Act attempts to assure that fish are harvested responsibly in accordance with regionally developed plans based on the available scientific information and meeting specified national standards. The Act is administered by the Secretary of Commerce, who provides funding and guidance to eight Regional Fishery Management Councils established by the Act and approves and implements fishery management plans prepared by the Councils.

Execution of management and conservation regulations in the fishery conservation zone (3 to 200 nautical miles) is the responsibility of the U.S. Coast Guard and National Marine Fisheries Service. The Department of Justice provides legal support for the enforcement program, prosecutes violators, and represents the United States in civil actions against seized fishing vessels. Because of international implications in regulating foreign fishing activity off U.S. shores, a close liaison between the Regional Councils and the Department of State is necessary.

Coastal States continue to maintain nearly full authority over the 3-mile territorial sea. The establishment of the Regional Councils did not preempt the existing mechanisms by which Federal, State, and local governments attempt to manage coastal region fisheries in the territorial sea. Such management is assisted by the State-Federal fishery management programs, set up by NMFS in 1971. Individual States make sure that the activities out from the coast to 3 miles and the Fishery Conservation Zone, which extends from the territorial boundary out to 200 nautical miles, are consistent with each other. On an interstate level, the fishery management group from one State works with its counterparts from adjoining coastal States to see that the activities and goals of each are compatible.

Three interstate Marine Fisheries Commissions (Atlantic States, Pacific States, and Gulf States) also serve a coordinating function in fishery management. These commissions are only indirectly part of the government's responsibility, but do receive Federal funding. NMFS and the Fish and Wildlife Service were designated as the research entities for these commissions, excluding the Pacific Commission. In cooperation with the Fish and Wildlife Service, these commissions regulate, mutually and uniformly, fishing in the regional territorial waters and bays.

The Department of State, through its Bureau of Oceans and International Environmental and Scientific Affairs, develops and carries out the Nation's foreign policy. Besides participating on the Regional Councils in a nonvoting capacity, negotiating International Fishery Agreements under the Fishery Con-

[17] 7 U.S.C. 1281.

servation and Management Act, and allocating the total allowable level of foreign fishing in the fishery conservation zone, the State Department is also active in other affairs that touch on the management of marine fisheries. It represents the United States in several international organizations and international fishery commissions that are coordinated by and under the auspices of the United Nations. It also represents the United States in the international commissions and focuses on the conservation and management of fishery stocks of domestic commercial interest. In a related function, the State Department, in consultation with NMFS, negotiates bilateral and multilateral fishing agreements with other countries.

The Marine Mammal Protection Act of 1972 was one of several related pieces of legislation written with the intent of protecting the dwindling numbers of marine mammals. Responsibility for administering the Act is divided between NMFS and the Fish and Wildlife Service. The Marine Mammal Commission, aided by its Committee of Scientific Advisors, is an advisory body which, among other responsibilities, keeps the Secretaries of Commerce and Interior aware of the status of marine mammals and makes recommendations for action as needed.

Related to the Marine Mammal Protection Act is the International Whaling Convention and the Whaling Convention Act of 1949. The Secretary of Commerce is responsible for carrying out the U.S. commitments under the Convention and provisions of the Act.

The Endangered Species Act also affects fishery and marine mammal conservation and management. This Act is more comprehensive than the Marine Mammal Protection Act, because it applies to all threatened or endangered fauna and flora. It authorizes the Secretaries of Interior and Commerce to determine and subsequently to make efforts to protect those species whose numbers have been severely diminished, and whose populations are therefore threatened or endangered. The Department of Commerce has responsibility for most endangered and threatened marine species of plants and animals; the Department of the Interior is responsible for all other species including manatees, polar bears, sea otters, and walruses. The Fish and Wildlife Service is responsible for the creation of wildlife refuges and for the regulation of their use by the public. The Marine Mammal Protection[18] Act initially exempted native Alaskans from its severe restrictions on the hunting and use of marine mammals. This, along with the preservation of native Americans' traditional hunting and fishing rights, leads to other conflicts in fishery management. The Department of Interior's Bureau of Indian Affairs protects traditional native fishing rights.

There are several activities, in addition to those of the Environmental Protection Agency, which protect the environmental quality of fishery habitats and restore those that have been damaged. The Fish and Wildlife Service (FWS) has major responsibility for habitat protection, working with other agencies as needed. In addition, the Department of Agriculture's Soil Conservation Service has a water conservation function which, in cooperation with State and local groups as well as other Federal agencies, enhances fish habitats and develops recreational fishery facilities.

FWS works closely with State fish and game agencies to provide financial and technical assistance to restore harmed areas and to create refuges for fish and other wildlife. Much of the land appropriated for these refuges is administered by the National Park Service and FWS refuge systems.

The concern of FWS is primarily with freshwater fish that include the anadromous species in freshwater areas. Since the States are responsible for the activities in their inland, coastal, and territorial waters, FWS provides technical assistance to them and supports multistate programs.

In addition to operating hatcheries, FWS also has the general mission of enhancing the recreational value of the coastal regions by establishing and managing wildlife refuges. These refuges are administered in cooperation with NMFS and State agencies. In addition, estuarine sanctuaries may be set aside under a provision of the Coastal Zone Management Act of 1972. (See chapter IV.)

Since many spawning grounds fall in territory under its control, the Agriculture Department's Forest Service also has a management responsibility for anadromous fish. The Army Corps of Engineers often aids in this management effort by construction of salmon ladders at dams and locks built and operated by the Corps.

Use of Fishery Resources and Development of the Domestic Fishing Industry

The role of the Federal Government in fishery resource use and domestic fishing industry development is to attempt to assist in the development and maintenance of a healthy commercial fishing industry, encourage the development of public and private aquaculture for selected species of fish, and assure the safety and quality of seafoods for U.S. consumers. To succeed, such assistance has to balance support for industry with protecting consumers' interest in low-priced, quality seafoods. Some of

[18] 16 U.S.C. 1361.

the functions undertaken in efforts to aid fishing interests include:

- assessments and exploratory fishing for species now underused, but existing in harvestable quantities in domestically controlled waters;
- development of vessel and gear technologies and harvesting techniques;
- techniques of product handling, processing, and storing;
- assistance in distribution and marketing;
- consumer education, product and quality safety standards, and inspection service; and
- financial assistance to the industry.

Assessments and Exploratory Fishing of Underused Species

NMFS is responsible for the resource surveys that serve as the basis of decisions by the Regional Fishery Management Councils. Although the primary function of this activity concerns the commercially important species, limited information is also collected on now underused species such as ocean pelagic stocks.

Development of Vessel and Gear Technology and Harvesting Techniques

A major policy issue is the extent to which the government should assist a commercial endeavor such as the fishing industry. Some, including the Office of Management and Budget, feel that if the domestic industry is to be competitive with foreign industries it should do most of its own research and development and not rely on government initiative and money. Others point out that the stated objectives of the Federal Government in fisheries cannot be achieved without assistance to industry.

NMFS, for instance, works on development of gear and techniques that will cut down on the incidental catch of marine mammals and unwanted and diminished fish stocks. These developments, often required by law, help the fishing industry when adopted by commercial users.

While developments from many research projects can be applied to the fishing industry, the Sea Grant program in NOAA is a major contributor. Recent programs include:

- development of a rake for harvesting the underused blue mussel off Maine's coast.
- multiuse vessel demonstration—In cooperation with the Pacific Tuna Development Foundation, Sea Grant plans to redesign and subsequently construct a 40-foot modern vessel with a refrigerated hold and limited electronic gear to demonstrate the economic feasibility of its use in developing local fisheries similar to the way that foreign fleets do.

Techniques of Product Handling, Processing, and Storing

The supply of fishery products to consumers should be adequate, safe, wholesome, and of high quality. To this end, the need for improved and increased inspection of fishery products is supported by both consumers and industry.

The Department of Agriculture has the principal responsibility for the development and promulgation of standards for product handling, processing, and storing of food; however, the Office of Sea Grant's Seafood Science and Technology Program focuses on these activities that pertain to fish and fishery products. The projects sponsored by Sea Grant in this area are primarily applied research, looking for answers to specific needs, such as the design and development of a squid processing machine, and the development and evaluation of an automatic shrimp deheading system.

The Department of Agriculture's Cooperative Extension Service applies funds to State agencies which have close, yet informal, association with Sea Grant's extension agents. Funds have been given for such studies as: *Application of Engineering Principles to Shellfish Processing* (University of Maryland) and *Impact of Production, Harvesting, and Procurement on Market Stucture of the Northeast Fishing Industry* (University of Maryland).

Assistance in Distribution and Marketing

Various government agencies have programs that provide a range of marketing services and support. These activities are designed to stimulate consumption of fishery resources.

There are major disagreements concerning the proper role of government in market stimulation. The special problems of the industry calling for financial support and incentives were noted in a General Accounting Office report:[19]

[19] U.S. Comptroller General. *U.S. Fishing Industry Can Be Strengthened by Developing Underutilized Fish Resource*. Washington, D.C., Government Printing Office, May 1975, pp. ii.

"Two characteristics unique to the fishing industry, the common property character of the resources and the typical small size of the firms, tend to deter substantial private investment in developing new fisheries. Fish in the ocean are subject to use for the most part by any fisherman. As a result, little incentive exists to invest in developing a new fishery because investors could not expect to capture more than a small portion of the economic benefits generated."

In contrast, others [20] see such industrial support as shifting the financial burdens of fishery promotion to the consumer, who pays the cost through higher commodity prices:

"On the one hand, the enhancement of demand as conducted by the private sector is a standard way of doing business and should not be interfered with. However, when government programs serve to enhance demand on established fish products, the programs have the effect . . . of typically increasing prices and profits. Thus, it is the consumer that pays, through taxes, for a program that raises consumer prices. . . .

"On the other hand, the generation of demand for fishing stocks which do not have established markets can contribute to broadening the supply base and by enlarging it thus serve to stabilize prices in the face of increasing demand."

In a recent action, the Department of Commerce's Economic Development Administration and NMFS have collaborated with the Regional Fishery Commissions to fund a study assessing the existing and potential foreign markets for fish and shellfish which are now harvested by domestic fishers.

NMFS has responsibility for assisting in the distribution and marketing activities of the fishing industry. NMFS cooperates with industry, the appropriate State organizations (such as dietetic and restaurant associations), and with the Department of Agriculture's Cooperative Extension Service to improve the efficiency and effectiveness of the use of fishery resources.

Agriculture's Cooperative Extension Service administers Federal funds to State Agricultural Experiment Stations for studies relating to agricultural marketing and rural development. Though most of the funds are directed to biological and ecological research, a portion is earmarked for marketing research and analysis. Some of the programs that have been funded in this vein were: *Hawaiian Fish Products Development* (University of Hawaii), *The Market Structure of the Fishing Industry in Maine and the Northeast* (University of Maine), and *Economics of the Commercial Fish Industry* (Texas A&M University).

Market analyses are also made by Agriculture's Economic Research Service and NOAA's National Sea Grant Program. The results of Agriculture's efforts appear in the quarterly publication *National Food Situation*. The Economic Research Service also works with NMFS for the incorporation of projected consumption and utilization trends for many fish and fishery products. Sea Grant promotes new marine businesses and industries by supporting research on the economic and legal barriers to fishery development.

The activities of several other governmental bodies can have a significant influence on the development of the fishing industry as well. These include the Federal Trade Commission (FTC) and the U.S. International Trade Commission (ITC). FTC aims at preventing general trade restraints and false or deceptive advertising. On the other hand, the ITC serves much more of an investigative function than a regulatory one. It reports its findings regarding the impact of trade and tariff policies on domestic industries and markets to the President, the Congress, and Federal agencies administering relevant programs. The Trade Act of 1974 details the ITC's responsibilities. Title II of this Act involves Relief From Injury Caused by Import Competition, and Title III deals with Relief from Unfair Trade Practices. Both are of particular relevance to domestic fishing interests.

The Department of Health, Education, and Welfare's Office of Education also assists the fishing industry by conducting, on a State-by-State basis, training programs in seafood merchandising and related occupations. This program is authorized by the Vocational Education Act of 1963.

Financial Assistance to the Industry

Several government agencies provide financial aid and incentives to the fishing industry. Grants, loans, and incentives constitute the government's most direct support to the domestic industry. The programs developed to stimulate the domestic industry are primarily concentrated within the Department of Commerce, Interior, and, to a growing extent, Agriculture.

For example, there are a variety of aids to fishing vessel operators. The Fisherman's Protective Act of 1967, as amended, guarantees that the government will reimburse the owners of a fishing vessel that

[20] U.S. Department of Commerce, NOAA. B. J. Rothschild, A Policy Framework for Fishery Management, Unpublished, 1977.

is seized by a foreign country on the basis of rights or claims not recognized by the United States. The Fishery Loan Program created by the Fish and Wildlife Act of 1956 authorizes financial assistance to commercial fishers for the purchase or repair of fishing vessels and gear. This loan program was created to facilitate the 1956 Act, which declared that fish and shellfish resources make "a material contribution to our national economy and food supply" and that the fishing industry can prosper and fulfill its function in the Nation's economy only if assistance consistent with that provided by the government for industry generally is provided. These programs, along with the laws which mandate them, are covered in the section dealing with economic development.

An important aspect of market assessment is the determination of consumer receptivity to the new products. To encourage acceptance, NMFS and Agriculture's Extension Service provide information regarding the availability, best uses, and nutritional value of these underused fish.

To protect consumers, the Department of Health, Education, and Welfare's Food and Drug Administration (FDA) is responsible for assuring that a high standard is maintained for the sanitary quality, safety, and wholesomeness of shellfish, fish, and fish products shipped in interstate commerce. These responsibilities are mandated by the Food, Drug, and Cosmetic Act. A special Seafood Inspection Amendment to this Act provides that inspection can be made at the request and expense of the industry. This does not mean that seafood products otherwise go entirely uninspected; FDA personnel periodically inspect such products.

The Department of Commerce has a voluntary seafood inspection program, but it covers only about 30 percent of U.S. production and about 5 percent of U.S. processing facilities. Federal and State inspection of the remainder is cursory at best and is found inconsistent by industry.

The Shellfish Sanitation Program was established to prevent human diseases that might result from eating unsafe shellfish. Unlike the system in most of the food industry, FDA, and not the Department of Agriculture, inspects plants routinely and makes sample analyses. Special care needs to be taken with fish and shellfish, because they are highly perishable.

Relevance of Fisheries to the National Interest

Fisheries impinge upon or are affected by many areas of public policy. Too often in the past fishery matters have been considered in isolation, rather than as a component of the Nation's food supply and food production industry or as a factor in international trade relations with key nations, as examples.

Viewed from the perspective of how fisheries affect and in turn are affected by the national interest in a range of policy areas, the importance of commercial and recreational fishing in this country is better appreciated. Although the fishing industry constitutes less than 1 percent of the Nation's gross national product, its impact is more extensive than this figure suggests.

There are also symbolic or aesthetic considerations that do not figure in economic or policy analyses. The Gulf shrimp fleet, the Gloucester fishing heritage, and the San Francisco waterfront each have values for their communities, and for the Nation, that transcend discussions of Federal policy matters. Maintaining the integrity of the U.S. commercial fishing industry, protecting recreational fishing opportunities, and restoring neglected waterfronts as healthy and colorful segments of urban communities are among the concerns of Federal, State, and local governments involving fisheries.

International Relations

With the adoption of the Fishery Conservation and Management Act in 1976, the United States expanded its exclusive fishery management authority from a 12-mile contiguous fishery zone to a 200-mile fishery conservation zone, increasing legal jurisdiction from an area of about 545,000 square nautical miles to over 2 million square nautical miles. This action brought what is said to be about 20 percent of the world's fish under U.S. management control, a control which extends to the domestic as well as the foreign fishing enterprise.

One major aim of the legislation was to curb foreign fishing off the U.S. coasts. An often-cited list during the Congressional debate leading to passage of the 200-mile bill was a tabulation of overfished species. A major reason some 10 to 15 species were judged to be overfished was the expanded harvests in recent years by modern foreign fishing fleets. Japan and the Soviet Union have been in the lead in developing efficient, long-distance factory fishing systems.

For the United States, however, to curtail sharply the fish available to a nation such as Japan raises significant international trade problems. The Japanese, unlike U.S. citizens, derive over 50 percent of their protein from fish. For this country to curb drastically the Japanese fishing operations off our coasts could jeopardize relations between the two countries.

Discussion between the two nations comes at a

time when the United States is applying pressure on Japan to reduce its exports of key articles such as automobiles, electronics, and steel, thereby cutting that nation's large trade surplus.

Fishing quotas for Japan within the United States 200-mile fishery zone have to be set in accordance with criteria in the Fishery Conservation and Management Act. The underlying fact is that in the past Japan has relied on United States waters for one-seventh of its worldwide catch. Japanese have taken significant quantities of Alaska pollock and bottom fish as part of a total catch in the United States averaging 1.5 million tonnes. As shown in table 3–3, the 1978 quota for Japan in the Pacific is about 1.1 million tonnes and only 8,000 tonnes in the Atlantic. This reduction has not been easy for Japan. At the same time, its allocation far exceeds that allowed any other nation.

Relations with the Soviet Union may also be affected by what the United States does within its fishery zone. Russia has been the second leading nation in exploiting the rich fishing areas of the United States. While Japan has concentrated on the Pacific, Russia has major fishing activities in both the Atlantic and the Pacific. As of January 1978, Russia had obtained 182 vessel permits for fishing in the United States waters, second only to Japan's 426 permits. Russia's total catch in United States waters has in the past been nearly 1 million tonnes, nearly one-tenth of its worldwide fishery harvest. The current, 1978, allocation for Russia will cut its take to half of its 1975 catch; but since the United States contribution to Russia's overall fishery intake is under 10 percent, the reduction is felt to be manageable. The major part of this reduction is in the Atlantic. It nonetheless has to be taken into account in the overall nature of relations between the two nations.

There are sensitivities involved with the fisheries of many other nations. In the past, disputes have flared with Latin American nations over the U.S. tuna and shrimp fishing off their coasts.

Relations with both Mexico and Canada involve major fishery issues. Mexico, in 1976, adopted a 200-mile economic zone, over which it intends to exercise jurisdiction not only over fisheries, but over other possible resource development as well. It became necessary for the United States to initiate negotiations with Mexico for the continued access of United States fishing vessels to Mexican waters.

In an agreement made in November 1976, the United States consented to limit access of domestic vessels to fish within 12 miles of Mexico. The United States also accepted quotas on certain species traditionally caught between 12 and 200 miles which will represent the surplus not taken by Mexican fishing vessels. This is fundamentally the same approach to foreign fishing that the United States established in its Fishery Conservation and Management Act.

The shrimping restrictions are extremely controversial among the industry and its supporters. In the past as many as 1,000 U.S. shrimping boats have plied Mexican waters. For 1977, during the transition to a zero catch after 1979, the United States agreed to cut the shrimp boats using Mexican waters by two-thirds to 318.

The United States and Canada have a number of fishing issues to be resolved between them. Both nations now have declared 200-mile fishing zones, and negotiations have been underway since 1976 on how to accommodate each other's interests. A major dispute is about the international boundary between the nations on the East Coast. Canada advocates a boundary that would allow it access to a portion of rich Georges Bank fishing ground; the United States advocates a boundary north of Georges Bank.

On the West Coast an agreement has to be reached on the extent to which salmon off one country can be caught by vessels of the other. There is also the question of the extent of Canada's access to the halibut off the Alaska coast. U.S. access to Northwest groundfish is also at stake.

Negotiations broke down in Spring, 1978, leading to a temporary halt in fishing by the two countries in each other's territory.

Another illustration of the complicated interrelationships of fisheries in the international arena is in Antarctica. The discovery of valuable resources in the Antarctic Continental Shelf and waters raises numerous potential conflicts. The waters of the Southern Ocean contain a number of potentially important food resources such as krill, and squid. The krill resource is underused. The declaration of extended jurisdictions by all of the major fishing nations and growing world requirements for food have heightened interest in development of krill fishing.

The Soviets and the Japanese are already marketing krill-based products, and many nations are experimenting with krill. Krill are small crustaceans that float in large masses near the surface of Antarctic waters. They are the basic food of many higher life forms in the area such as birds, fish, seals, and whales and are an important potential source of high-quality protein. George Bertrand of the Council on Environmental Quality has estimated that a 70-million-tonne annual harvest of krill would equal, in protein value, the entire fish catch from the rest of the world's oceans.[21] Only Japan and U.S.S.R. now use krill for human consumption. As a result, less than 1 million tonnes are caught each year. West

[21] American Association for the Advancement of Science. "Antarctic Problems: Tiny Krill to Usher in New Resource Era," *Science*. April 29, 1977, p. 504.

Germany's development of krill fishing techonology in recent years may facilitate larger catches.

Estimates of standing stocks and potential yield of krill vary greatly. The Food and Agriculture Organization of the United Nations has estimated the potential yield of stocks to be at least 100 million tonnes per year.[22] The Second Report of the United Kingdom Fisheries Research and Development Board suggests that an annual fishery of 50 million tonnes could be sustained.[23]

The United States is participating in the negotiation of a treaty concerning living marine resources of the Antarctic. The U.S. objective is to ensure that conservation and management practices contained in the treaty will provide the maximum benefit to the participants while providing for the continuance and conservation of the resource. Regulation under the International Whaling Convention and the 1972 Convention on Antarctic Seals also must be considered in the formulation of a treaty. Whether these objectives can be made consistent with other nations' interest in using the fishery resources remains to be seen. There is also a question as to the extent the United States can or should develop its own krill fishery.

Food Policy

If the Federal Government adopts a comprehensive and consistent food policy governing its multiple activities affecting what U.S. citizens eat, one question will be the role of fish in the diet. There is no question that fish already are important in the American diet, although small compared with U.S. meat consumption and with fish consumption in other nations. Nonetheless, 10 percent of all frozen food products purchased in this country in 1974 were fish.[24]

Fish generally are an excellent source of protein and have a higher portion of polyunsaturated fats than meat. Most fish rank near the top of the list of foods with low amounts of calories and fat. On the other hand, hot dogs, hamburger, luncheon meat, and pork rank near the bottom. For persons requiring less fat, less cholesterol, and fewer calories in their diet, finfish such as haddock, halibut, perch, smelt, sole, and tuna (water pack) are recommended. Most shellfish, although low in fat and calories, are high in cholesterol.

From a Federal policy standpoint, several questions arise immediately. The foremost is how much the government should do in the way of telling people what they ought to eat? Is there more to be done than educational efforts, such as the December 1977 report of the Senate's Select Committee on Nutrition and Human Needs, *Dietary Goals for the United States?* This report spelled out what the Committee saw as the realities of the American diet—too much sugar and salt, for example. The report justified its recommendation that less meat be consumed in favor of poultry and fish. Publications of the Department of Agriculture have given similar findings and recommendations.

If the Federal Government decides to promote increased consumption of fish, what should be done to bring this about? The government, most especially the Defense Department, now purchases food directly. But an effort to increase fish purchases at the expense of meat would not be well regarded by a cattle industry faced with rising costs of doing business.

Public education as noted above, is another method by which the Federal Government can attempt to change American eating habits. But just as the Senate report cited above was controversial, so too are many findings in the nutrition area. A recommendation for increased fish consumption, for example, will encounter resistance from some who question the safety of eating fish compared with meat, because of the difference in inspection systems and perishability.

There are suggestions that fishery matters be included in the vast programs of the Department of Agriculture, which touch on every aspect of food policy. These suggestions have been resisted vigorously by the fishing interests, because of fear that fishery matters would be subordinated to the interests of more potent constituents of the Agriculture Department such as the dairy and meat industries.

The current food policy review within the executive branch may provide some guidance on how this Administration should address the relative balance between supporting a meat and poultry industry on the one hand and promoting fish consumption on the other. The question is raised directly with aquaculture. To what extent should the Federal Government support efforts to raise fish? To the extent such efforts succeed, they can be seen as diverting American consumers away from other protein sources.

What is needed, in short, is an overall food policy that will provide guidance and balance to the vast amounts of money spent each year in this area. An overall food policy should provide a framework in which to assess the relative value of fishery development and begin to provide answers to questions raised by the Office of Management and Budget, among others, as to the justification of some of the support programs for commercial fishing.

[22] Food and Agricultural Organization. Informal Consultation on Antarctic Krill, *FAO Fisheries Reports* No. 153, Rome, 1975.
[23] Fisheries Research and Development Board, Second Report 1974/1975, Her Majestry's Stationery Office, London.
[24] U.S. Comptroller General, op. cit. note 4.

Concern about fishery resources is a key factor in current efforts to upgrade water quality in the Nation and to protect estuarine and wetland areas. Fish kills and closing of fishing or shellfish areas are among the most dramatic indices of poor water quality. Repeated occurrences of such events helped build public support for the current water cleanup program that began in earnest in the early 1970s. On the negative side, announcements of fish contamination immediately and adversely affect sales.

Those involved in recreational fishing have traditionally been active supporters of environmental protection and improvement. The increase in recreational fishing in recent years has, therefore, produced widespread concern about water quality and protection of fish habitats by this growing and vocal segment of the public.

Environmental concerns are many. They include fear of excessive destruction of fishery habitats, questions about the long-term effects on reproduction from some of the chemicals introduced into the marine environment, and concern about whether fluctuations in catches of various species may be related to ocean dumping, dredging, or other environmental alterations.

Two recent cases involving the siting of energy facilities in coastal and offshore regions—a proposed oil refinery at Portsmouth, Va., and lease sales of Outer Continental Shelf sites for oil and gas drillings in the Georges Bank Trough—have highlighted the issue of the conflicting uses of the oceans and the potential impacts upon fish and their habitats and the fishing industry.

The Federal involvement in the proposed Portsmouth, Va., facility centers around the requirement for an Army Corps of Engineers permit to construct a marine terminal for the tankers. The locations selected by the Hampton Roads Energy Company is a 620-acre site on the Elizabeth River near Norfolk, Va. The site is within several miles of a rich shellfish area in the James River and relatively close to crab areas of the Chesapeake Bay.

The Department of Energy supports the proposal, the city of Portsmouth is enthusiastic about it, and the Commonwealth of Virginia has given its approval. In opposition are the Environmental Protection Agency, the Fish and Wildlife Service, and the National Marine Fisheries Service (NMFS). The final decision is likely to be made by the Army Corps of Engineers after the case makes its way through regional office review. Backers or opponents are felt likely to sue whichever way the Corps decides.

The Portsmouth proposal illustrates how complex environmental concerns about fishery resources become. Offsetting the danger to a $50 million annual oyster industry (an estimate by the Oyster Industry Associations) is the far greater economic impact of a refinery proposed to handle 175,000 barrels a day of oil imported from the Middle East in supertankers. One estimate of the project places its value at $550 million; the addition of the refinery would, it is estimated, increase the city of Portsmouth's tax base by 50 percent.[25]

NMFS filed formal objection to the proposal June 22, 1976, on several grounds (the large amount of dredge spoil involved, destruction of river bottom habitats, and waste runoffs from the plant), but primarily because of the danger which an oil spill represents to the James River oyster seedbeds in particular and marine life in general. NMFS recommends, in fact, against locating any major industrial facilities such as a refinery in productive and fragile estuarine areas.[26] It was these same oyster beds in the James River that were threatened by the chemical kepone a few years ago.

The oyster beds have been described as the "sole commercially important source of seed oysters in the Bay region and (the source of) supply 75 percent or more of the seed which is transplanted to growing areas." [27]

The Fish and Wildlife Service (FWS), in its recommendation against issuance by the Corps of Engineers, stated, ". . . this Service believes the construction and operation of a refinery complex in the Hampton Roads area will result in a significant contribution to the long-term diminution of the area's fish and wildlife resources and could, in the event of a single, major oil spill under certain conditions, result in the elimination of a significant regional shellfish industry." [28]

The FWS concerns are four: the initial dredging and maintenance dredging, oil spills, wastewater discharge, and related impacts on the area as a result of the refinery.

The Environmental Protection Agency's objections range from water quality considerations to effects of the refinery on air quality.

The Portsmouth refinery application demonstrates several of the types of environmental concerns that may affect fisheries, namely dredging, handling of dredge spoil, industrial wastewater treatment, and the threat of oil in enclosed marine environments.

---

[25] American Association for the Advancement of Science, *Science* February 10, 1978, p. 668.

[26] Letter, NMFS regional office, Gloucester, Mass., to District Engineer, U.S. Army Corps of Engineers, Norfolk, Va., June 22, 1976.

[27] Memorandum, David H. Wallace, Acting Assistant Administrator for Fisheries, NOAA, to Richard Frank, Administrator, NOAA, February 13, 1978.

[28] Letter, David Riley, acting Regional Director, U.S. Fish and Wildlife Service, Boston, Mass., to District Engineer, U.S. Army Corps of Engineers, Norfolk, Va., August 27, 1976.

Similarly, prospective offshore drilling in the Georges Bank has been a concern, because of possible environmental degradation of that area of the ocean. While there is certain to be a degree of environmental damage associated with this development, it is felt that most of these effects will be localized in the area immediate to the drilling facilities. A Woods Hole Oceanographic Institution report states that present evidence "does not suggest that a single major offshore spill could be a long-term threat to total fish stocks." [29] The report also noted, however, that many unknowns remain to be worked out concerning offshore spills. What is known about the impacts of oil pollution in the ocean on fisheries and fishing from accidental or chronic (operational) spills comes from observations in the Gulf Coast where offshore petroleum development has existed for 25 years.

Although the activities in the Gulf have increased in recent years, many of these drilling rigs have been assembled in the midst of productive fisheries, which continue to produce healthy landings. A National Academy of Sciences study found that the catch has remained high despite 30 years of oil spills from accidents and chronic (operational) sources totaling an estimated 1.1 million barrels.[30]

Although the long-range, cumulative effects of oil spills on fish and their environment are not known, most environmental concerns over development of Georges Bank oil and gas come less from fears of offshore oil spills than over the disruption of the coastal environment from transportation of oil to the shore—both from the oil itself and from nearshore dredging. As the Woods Hole report states, "Whether pollution problems nearshore are increased or decreased by offshore development is a function of the changes caused by offshore oil in the entire network of transportation, handling and processing of petroleum in the coastal area." [31]

Except for an unpredictable massive oil spill, the environmental disruptions do not appear to have the potential of disrupting fishing activities in one of the world's most productive fishing zones. Even such an event does not spell doom for the area. Ten years after the *Torrey Canyon* disaster, the nearby coastal area, once covered with oil sludge, seems to have recovered to its previous condition. On the other hand, oil from the *Argo Merchant* spill has resulted in some mutagenic effects to fish eggs.

One of the larger issues revolves around the competition for ocean space. Several potential drilling sites, historically successful fishing areas, were not made available to the oil companies. The actual space occupied by the rigs themselves is nearly insignificant. The Woods Hole study estimates that a realistic estimate for the "hypothetical reduction of catch on Georges Bank due to the presence of platforms is probably . . . 0.06 percent." [32]

A potential danger to fishing is the presence on the seafloor of drilling operation debris that can snag fishing gear. The U.S. Geological Survey can, and does, require OCS leaseholders to drag a production area when it is shut down. Wells that are sealed off below the seafloor can become exposed if seafloor sediments shift. The Geological Survey reports few complaints from fishing interests in the Gulf of Mexico in recent years about seafloor obstructions from OCS operations.[33]

Another major factor in environmental protection critical to fisheries is the condition of the Nation's estuaries and related wetlands. (See chapter IV for a discussion of coastal wetlands protection.)

Many fish species use the estuaries as nursery areas, but spend their adult lives in the open sea. Many other marine species spend their entire life in a single estuarine system, and still others use estuaries as a passage between the sea and rivers. For example, about 75 percent of commercial fish and 95 percent of recreational fish spend some part of their life histories in estuaries.

Of those life forms that are either sedentary or forage a small area, clams, oysters, crabs, lobsters, and the like have economic significance. The estuarine zone also plays an important role in the life cycles of menhaden, salmon, shrimp, and many other species of economic importance.

Population growth and industrial development have, in numerous places, caused severe and damaging pollution to estuarine areas. The discharge of untreated human sewage and stormwater runoff from from cities can cause bacterial contamination. Discharges of decomposable organic materials from human sewage and some industrial wastes deplete dissolved oxygen resources. Further, toxic materials from industrial wastes, land runoff, pesticides, herbicides, and chemical manufacturing plants may directly kill fishery resources, cause damage to their reproduction capacity, alter behavior, contaminate tissue, and cause mutagenic effects.

Some materials act as fertilizers and stimulate the growth of certain life forms at the expense of others. Inert materials such as sediments fill in estuarine areas and smother bottom-dwelling life forms.

Sample problem areas around the country include the following:

New England—During the late summer, dissolved oxygen depletion is common in Boston Harbor; some areas have nuisance algae growths. Shellfish

[29] Woods Hole Oceanographic Institution. *Effect on Commercial Fishing of Petroleum Development off the Northeastern United States—A Report from the Marine Policy and Ocean Management Program.* Woods Hole, Mass., April 1976.

[30] National Academy of Sciences, Ocean Affairs Board. *Petroleum in the Marine Environment.* Washington, D.C., 1975.

[31] Woods Hole Oceanographic Institution, op. cit. note 29, p. 24.

[32] Ibid., p. 23.

[33] Personal communication, Conservation Division, U.S. Geological Survey. Department of the Interior.

harvesting in the area is restricted, because of bacterial contamination. Industrial operations and communities cause localized pollution problems centering around Penobscot Bay and River, Maine. The resultant bacterial pollution from raw sewage disposal has forced the closing of once highly productive clamming areas. Sludge deposits covering much of the bottom of the bay and river are believed responsible for decreases in the harvests of lobster and scallop. Anadromous fisheries in the area have also suffered because of a completely depleted dissolved oxygen supply during the summer owing in part to dams. The polluted condition of the Penobscot Bay and River has, however, resulted in strong cleanup action by the State of Maine and the Environmental Protection Agency. The diminution of the salmon fishery has been directly associated with the increase in dambuilding, lumbering, and other industrial activities along the New England coast.

Mid-Atlantic—Pollution in major Atlantic population centers has caused a decline in coastal environmental quality. Off New York it has adversely affected nearby ocean waters as well. In Raritan Bay, N.J., and Jamaica Bay, N.Y., many formerly productive shellfishing areas have been closed. Dumping of treated sewage sludge (4 million cubic meters in 1977) and acid wastes in waters off New York City have adversely affected fish in that area. Fin rot and other diseases are apparent in some fish caught in the area. Some bottom dwelling populations of fish are smothered or otherwise severely affected. Many embayments on the New Jersey coast are affected from land and river runoff carrying among other pollutants, septic tank effluent, and fertilizers.

South Atlantic—Pollution problems in this region are associated with the discharge of municipal and industrial wastes, especially from pulp- and papermills into confined harbor areas. The result of such dumping is depressed dissolved oxygen and a high content of organic material in the water. This region is also characterized by modification of the estuarine system, resulting in heavy siltation and extensive destruction of marshes and estuaries, which play a major role in the life cycle of two major commercial fishery products, menhaden and shrimp. Crabs and oysters also are prevalent in these waters.

Gulf of Mexico region—Pollution and industrial development in the Gulf of Mexico and surrounding area are similar to those of the South Atlantic region. In the Gulf region, however, coastal water pollution may be linked to a wide variety of chemical manufacturing. The waste products of such industries can subtly damage marine resources. A further source of pollution in the Gulf of Mexico area is pesticides and fertilizers draining into the Mississippi River from croplands in the Midwest. Fish kills in the Mississippi River have been directly related to excessive concentrations of pesticides. The Mississippi River delta has an intricate system of channels and marshes that support an extensive oyster and shrimp harvest. Coastal areas are also damaged by creation of canals to move oil drilling equipment; the dredging upsets the ecological balance in the delta area through siltation and change in water salinity.

West Coast—In the San Francisco Bay area, development of industry and the metropolitan area have caused the filling of many marshlands and estuarine shallows. The result of this land fill has been the decline or destruction of crab and shrimp fishing. This area was one of the largest areas suitable for nursery grounds for ocean fish of the Pacific coast.

Tidal rivers and headwaters of many of the streams of the Northwest region are the spawning grounds of several species of salmon. Salmon require cool, clean water with a small temperature range for reproduction and are especially sensitive to toxic materials. The construction of numerous high dams on major rivers such as the Columbia has raised the water temperature and altered migration patterns.

Industrial wastes, discharged near the mouth of the Columbia River, have stimulated alga growth to the extent of fouling the gill nets of commercial fishermen. In Puget Sound, Wash., wastes from pulpmills reduced dissolved oxygen, created sludge deposits, and increased the concentrations of suspended solids in several embayments. These changes in water quality have already adversely affected the salmon and shellfishery resources of Bellingham Bay and other parts of Puget Sound.

Alaska and its neighboring oceans are rich in a variety of natural resources that are currently being developed in a major way. Alaska's southeastern coastal forests are being cut for timber and pulpwood. Paper- and pulpmills have caused some water quality degradation. Pollution from possible oil spills and other toxic materials threatens the living resources of Alaska waters including salmon and king crab.

Wildlife Management and Conservation

Some forms of wildlife and marine mammal protection efforts can conflict with commercial and recreational fishery interests. At the same time, wildlife protection activities in a sound conservation program will result in improved fisheries.

The wildlife activities of the Federal Government that protect fishery habitats are sometimes controversial, with debate centered on the extent to which the Federal Government should be involved and how much to spend for this activity.

In many instances, marine mammals are major predators of fish. As restrictions on the killing of these mammals continue, the populations will grow and the consumption of fish will increase. There are instances where mammals eat valuable marine species: the California sea otter consuming abalone is one such instance. Alaska sea lions eating salmon, and both sea birds and marine mammals eating Alaska squid are other examples.

The wildlife and mammal protection activities that conflict with fisheries are more complicated and represent the type of interrelated policy issues with which fisheries often are involved. The controversy over the Marine Mammal Protection Act's restriction against the killing of marine mammals has been high since the Act was adopted in 1972. The tuna-porpoise relationship, which results in accidental drowning of porpoise during the catching of Pacific tuna, is the most widely publicized of these conflicts. The controversy has abated because of decreased porpoise kills, but it is not yet over.

Government regulation of yellowfin tuna purse seine fishing to curtail the accidental drowning of porpoise has had several effects. It has been a factor in the recent transfer of six U.S. tuna vessels to foreign registry. Yellowfin tuna imported to this country are subject to the provisions of U.S. law regarding porpoises killed in the course of foreign fishing operations. However, former U.S. boats can harvest tuna on the high seas and ship their catch elsewhere without such restrictions.

The solution to the problem has been to institute progressively lower quotas of porpoise kills rather than insist on an immediate moratorium. While some environmental organizations have protested this approach, there seems to be general accord that it is reasonable. The U.S. tuna fleet is a distant-water fleet, and its modern vessels are one of the bright spots in U.S. commercial fisheries. The quota approach has permitted it to continue to operate, although not without difficulty. At one point, the tuna fleet refused to go to sea in protest over the porpoise quotas.

The allowable porpoise deaths to be permitted during the coming 3 years were announced by NOAA December 16, 1977. The quotas are 51,945, 41,610, and 31,150 for the eastern tropical Pacific tuna fishing area during 1978, 1979, and 1980. The regulations, issued by NOAA, also require use of specific equipment and techniques to enable the porpoise kill to be reduced to the required levels. The requirements are enforced by NMFS observers who travel with the tuna vessels and make first-hand counts of dead porpoises.

The kills in earlier years were estimated to be much larger, namely 310,000 in 1971 and 104,000 as late as 1976. Use of nets with strips at the top that allow the porpoise to escape and use of a "backing down" technique by purse seine vessels are credited with bringing about the current reduction. Industry developed the new method, which represents an additional expense.

Another example of conflict is in Oregon where sea lions are moving into rivers and estuaries where they did not appear before. Angry commercial and recreational fishing people claim that the sea lions interfere with runs of salmon and steelhead. The State reports finding dead sea lions with bullet holes in their bodies.[34]

Another of the many examples of conflict between marine mammal protection aims and fishery interest occurs in Hawaii. An effort to develop a spiny lobster fishery is complicated by the fact that the monk seal eats them. To protect the seal population, limits have been proposed on the taking lobsters. For instance, no lobsters are to be taken from within 18 meters (10 fathoms) of the islands in the northwest part of the State of Hawaii where the seal lives. Complicating this issue is the fact the seals live on a wildlife refuge managed by the Fish and Wildlife Service, whereas the lobster fishery effort is being supported by the NMFS and the Sea Grant Program of NOAA.[35]

The Hawaii case is but one example of the complexities involved in wildlife management and fisheries. The Endangered Species Act, aimed at perpetuating existing species of animal and plants, is an additional complication. Coordination among Federal Government agencies is required, Federal and State relationships are involved, and planning has to encompass a total environmental system so that the effects of protection of one species is considered in relation to the rest of the populations. This sort of interdisciplinary and intergovernmental activity is not easily accomplished.

Law Enforcement

Enforcement of the Fishery Conservation and Management Act of 1976 is the joint responsibility of the Department of Commerce and the Coast Guard.

To enforce the Fishery Conservation and Management Act ashore, NMFS special agents make dockside inspections of fishing vessels, fishing gear, catches, logbooks, and landing records. At sea, NMFS and the Coast Guard operate joint aerial and surface patrols as the means of enforcement. Shoreside enforcement activity focuses on U.S. fishers, the

[34] From briefing memorandum for the Marine Fisheries Advisory Committee prepared by NMFS, February 1978.

[35] University of Hawaii, Sea Grant Newsletter, University of Hawaii Sea Grant Program, Honolulu, January 1978.

at-sea effort involves both U.S. and foreign fishers.

Foreign fishing within the U.S. fishery conservation zone is monitored for compliance with quota restrictions. Compliance is said to be good. It should be noted that although foreigners fish only on surplus stocks that are abundant, they can affect depleted stocks through incidental catches of diminished species. Regulations are designed to the extent possible to minimize incidental catches and to protect depleted stocks.

U.S. fishing in the fishery conservation zone is less well regulated than foreign fishing and may affect depleted stocks. Noncompliance can have a great effect, because a number of stocks are already in marginal condition. Compliance problems are compounded, because programs involving U.S. fishing operators require a high degree of support from the industry to succeed—support that is hard to obtain when quotas sharply curb allowable fishing.

Economic Development

Economic development considerations involve fisheries, particularly commercial fisheries, at a variety of levels.

A number of specific forms of Federal assistance have been attempted. As with many attempts by the government to provide useful assistance, some efforts have been on target and others wide of the mark.

In another type of program to promote fisheries, efforts at comprehensive, intergovernmental programs intimately involved with private interests have been attempted. One such effort in Gloucester, Mass., is an example.

And at a third level, fisheries as components of urban waterfronts can be key components in bringing outmoded, but colorful waterfront districts back into widespread use.

Affecting all efforts to assist the fishing industry, and thereby improving the U.S. catch and consumption of fish, is the nature of the industry. The industry is really not a unified entity; it is divided into many parts, dependent on geography, the type of fish caught, and the age of the equipment. There are, nonetheless, some generalizations that can be made about the U.S. commercial fishing "industry."

As an occupation, it is divided into many small parts scattered around the country. Almost all in the industry are small business people, although some large corporations have moved into the field, particularly in packing. Most U.S. vessels are small and old; the capital required to build modern, long-distance vessels is hard to come by, as are the crews needed for the extended trips to sea required to make large, modern vessels economic.

Packing and processing is also generally a small business, with most units employing fewer than 20 employees.[36] Large firms, however, often own the plants.

Many components of the fishing community have traditionalism and independence. This leads to resistance to change, unwillingness to attempt to catch and market new species, and distrust of governmental efforts to be of assistance, no matter how well meaning. At the same time, private capital has been difficult to raise, because of the high-risk nature of the fishing business. There are indications, however, that certainties provided by adoption of the U.S. 200-mile fishing limit may encourage increased investment in U.S. boats and processing plants.

One major inhibiting factor is that American consumption of fish, while growing in recent years, is restricted to several traditional species and groups. About 70 percent of the total consumption is groundfish, shrimp, and tuna.[37]

There are a variety of direct Federal aids such as loans and grants to the fishing industry, designed to enable it to modernize and better keep up with foreign competition and thereby supply a larger supply of the domestic consumption. These types of loan and grant programs have, beyond the immediate aims of assisting U.S. fisheries, the goal of contributing to a reduction in the U.S. balance of payments due to fish imports and thereby contributing to a strengthened dollar in international markets.

NMFS has three authorized programs of direct assistance to the industry: direct loans (currently not operating), guaranteed loans, and tax deferrals. The direct loan program was suspended in 1973, because of an alleged poor repayment record; Congress may reactivate this type of aid. The purpose was to provide loans when regular commercial channels were not available, reflecting past reluctance of commercial lending sources to support many segments of the commercial fishing industry.

The guaranteed loan program functions with 75 percent of commercial loans for work on vessels backed by NMFS (for a fee). As of August 1976, such loans totaled $12 million, with $6 million more approved and applications for an additional $19 million pending, indicating its utility to the industry. At the same time, many operators are unable to provide the required down payment of 25 percent.

The tax deferral program permits income taxes to be set aside on that portion of income which an operator agrees to place with NMFS and eventually

[36] Speech, Joseph W. Slavin, Assistant Director for Fisheries Development, NMFS, to National Marine Fisheries Advisory Committee, October 5, 1977.

[37] Ibid.

spend on vessel modernization. This program through June 1976 had resulted in the accumulation of $75 million in deposits.

There are other sources of Federal assistance to encourage the improved economic condition of the domestic fishing business. The Small Business Administration makes loans to various components of the fishing industry. A compilation of the agency's activity in fiscal year 1975 showed 217 loans totaling $6.5 million to "fishermen," and manufacturers, wholesalers, and retailers of fishery products.[38]

A recent review in Massachusetts of Federal support programs for commercial fishing interests compiled a list of 13 assistance programs for vessel purchase, a like number for vessel renovation, 11 programs for help with onshore facilities, and 6 programs for aid to public onshore facilities. (See table 3–6.)

Given the independent nature of persons in the fishing industry and the potentially confusing array of Federal assistance programs, there are suggestions that assistance needs to be better focused and easier to obtain if the programs are to achieve the objective of a stronger domestic fishing industry.

[38] U.S. Comptroller General, op. cit. note 4, p. 58.

There is one major form of indirect assistance that provides funds for research and marketing aid. Under the Saltonstall-Kennedy program, 30 percent of the receipts from imports of fishery products are to be applied for these purposes. The amount appropriated in 1977 was $7.9 million. The idea is to use the receipts from imports to help develop the domestic fishing industry and eventually cut down on the amount of fish imported.

The Department of Commerce's Economic Development Administration (EDA) has a loan program potentially useful for onshore facilities.

As this brief listing suggests, there is a variety of possible sources of direct assistance to the fishery industry. There are problems with some of the specific programs (the 25 percent requirement for vessel modernization assistance is a barrier to some). More basic is the highly individualistic nature of the people in the fishing industry, their lack of information about some of the types of help available, and their unwillingness to put up with what they view as governmental red tape even when the information is at hand.

Illustrative of the type of comprehensive project, in which members of the fishing industry take part,

Table 3–6—Federal support programs for commercial fishing interests [1]

Federal Programs	Eligible Activities			
	Vessel purchase construction	Vessel renovation	Private onshore facilities	Public onshore facilities
A. Economic Development Administration				
1. Public Works and Development Facilities				x
2. Business Development Loans	x	x	x	
3. Title IX	x	x	x	x
B. Small Business Administration				
1. Section 7(a) Loans	x	x	x	
2. Section 502 (LDC) Loans	x	x	x	
3. Disaster and Emergency Loans	x	x	x	
C. National Marine Fisheries Service				
1. Capital Construction Fund	x	x		
2. Fishing Vessel Obligation Guarantee	x	x	x	
3. Fisheries Loan Program	x	x		
4. Import Duties Fund				
D. Environmental Protection Agency				
1. Section 201				x
E. Farmers Home Administration				
1. Guaranteed Business and Industrial Loans	x	x	x	x
F. Farm Credit System				
1. Production Credit Association Loans	x	x	x	
2. Banks for Cooperatives	x	x	x	
G. Department of Housing and Urban Development				
1. Community Development Block Grants	x	x	x	x
H. Department of Commerce				
1. Trade Adjustment Assistance	x	x	x	x

[1] Source: Commonwealth of Massachusetts, *A Report of the 200-Mile Fisheries Work Group*, Lt. Govenor Thomas P. O'Neill, III, chairperson, no date, page 23.

can be seen in Gloucester, Mass. With major assistance from EDA (specifically using grant funds from Title IX of the Public Works and Economic Development Act), Federal, State, and city officials together with private groups have pulled together a varied package of projects to revive that city's fishing industry. The project has two principal components as well as a series of studies into additional possible forms of assistance to the industry. After a 2-year delay due to engineering and legal complications, construction was scheduled to begin in June 1978 on a new freezer facility on a reconstructed State pier. Expanded docking space is to be provided, a gear storage building constructed, and stalls renovated. The Economic Development Administration (EDA) is putting forward more than $6 million towards this effort. An additional program is a revolving loan fund of $250,000, with support from EDA, New England Regional Commission, and the city. Money from this fund is available to boatowners unable to get financing otherwise. Officials report that repayments have been excellent.

The Massachusetts State government has put $1.2 million into the project in its original form, and an additional similar amount to help meet unexpected construction costs. The city, county, and regional commissions have invested funds as have NMFS and the Sea Grant Program. Additional projects include a marketing effort on two underused species, the dogfish shark and the ocean clam. A feasibility study of a large vessel pier will be made. Surveys of the handling of fish waste and of a fresh fish wholesale operation are additional elements.

A third dimension of the relationship of the fishery industry to broader national economic development interests is as a key component of waterfront areas. Frequently, waterfronts are decayed and neglected, a condition as true in some newer cities as it is for older communities in the east and south. The fishing community is sometimes a major occupant of the waterfront area or, in major port cities, a relatively small, but a highly visible and colorful element whose preservation and restoration could be a key in a waterfront redevelopment.

Just as new methods of handling cargo have left many port facilities unused and dilapidated, so have changes in distribution methods of fish made older facilities outmoded. What has happened in some areas is that the fishing industry, which occupied prime waterfront land, has been replaced by higher income-producing facilities, while fish distribution is handled at a warehouse distant from the waterside.

In successful fish districts along the waterfront, as in San Francisco and Annapolis, Md., the area is a magnet and many businesses directly or indirectly related to the catching, distribution, and consumption of fish locate nearby. Preserving and enhancing these districts is a challenge to city governments. The tradeoffs are the balancing between the tourist attraction on one hand and the possibility of an office, residential, or commercial redevelopment on the other.

Some fishing industries on the waterfront are perceived to be small, smelly, dirty, and frequently housed in old buildings. This has made it a prime target for redevelopers who prefer more suitable inhabitants of waterfronts, particularly when efforts are being made to attract residential and office uses to such areas. This was the case in the Boston waterfront redevelopment in recent years, for instance.

Federal-State Relations

The relationship of Federal and State governments in the fishery area is, unsurprisingly, complicated. The fishery conservation zone extending from 3 to 200 nautical miles offshore is under Federal control. The offshore sea to 3 miles involves a division of authority. The States exercise authority over recreational and commercial fishing in the territorial sea, whereas the Federal Government controls navigation, pollution laws, dangerous cargo, and vessel safety.

Under the provisions of the Fishery Conservation and Management Act of 1976, fishery management plans for the area beyond 3 miles are prepared by the Regional Fishery Management Councils, which have representatives from the Federal and State governments, local communities, and private interests. The Councils prepare the management plans, but the plans are implemented by Federal regulations.

The sharing of the decision-making process is intended to be balanced. On the one hand, the Councils only recommend fishery management plans to the Secretary of Commerce. On the other hand, the Secretary's appointment power for Council membership is restricted to nominees submitted by the governors together with certain designated members, such as the NMFS Regional Director.

The Councils have been termed "a new form of government," because they are unlike traditional State, local, or regional entities or intergovernmental advisory bodies. A recent report to the Marine Fisheries Advisory Committee noted that numerous questions and uncertainties have arisen about the relationship of the councils to the Federal Government, especially the Commerce Department.

The relationship of NMFS to these Councils will evolve in time. At present there is naturally some confusion about the relative roles of each. NMFS has a support role for the Councils, including providing funding in their budgets for operation and a responsibility for providing the data on which domestic quota decisions based on the optimum yield concept will

presumably be made. NMFS has also prepared the preliminary fishery management plans that permitted limited foreign fishing while awaiting completion and approval of the final managements plans by each Council. At the same time, NMFS performs a screening function for the Secretary of Commerce in advising whether the plans drawn are, in its view, in the national interest. According to the Congressional Office of Technology Assessment review of the 200-mile management program, this dual role is a present source of confusion.[39] Table 3–7 shows the division of functions.

Among the potential problem areas are budget support and research priorities. Council budgets must be approved by NMFS and NOAA. In the event of conflict between the Councils and the Federal representatives, this power could be a factor. Balancing this is the fact that the Council representatives come through the State political process; they were selected for nomination by State governors, and can be presumed to be in positions to bring some pressure to obtain funding needed.

Research needs may be seen differently by the Councils and NMFS, which is charged with performing the work, and for which money is budgeted in support of implementing the Fishery Conservation and Management Act. As it stands, the councils may make recommendations, but the Department of Commerce has the final say.

As it is, the concept of the Regional Council stands out as a pioneering effort at sharing power between principally the Federal and State governments, with private interests represented, in what is legally a Federal resource management area.

While the Regional Councils may represent a hopeful trend in State-Federal relations, when it comes to administering laws and regulations within the 3-mile territorial sea, the picture is different.

Some fisheries are managed under comprehensive plans; others are managed under regulations without a strong scientific basis. Some fisheries are continually being researched and are without effective management, and others are not being managed at all.[40]

From a national standpoint, the problem of concurrent jurisdiction by several States over a particular fishery may be a major barrier to sound management. As examples, bluefish occur in the waters of 14 States and menhaden in the waters of 16 States. Because each individual State creates laws for fishery management within its jurisdiction, differing regulations sometimes exist among States. For example, size limits on striped bass vary from Maine and South Carolina where there are no limitations to New Jersey, which requires the fish to be 12 inches long to be retained. Some States have divided authority within the State, which adds further difficulties to fishery management in that State.

The institutions dealing with territorial sea fisheries are:

- The States—each State has the authority to manage fisheries within its legal boundaries.
- Interstate Marine Fisheries Commissions—the Atlantic States Marine Fisheries Commission, the Pacific States Marine Fisheries Commission, and the Gulf States Marine Fisheries Commission, were established to develop a joint program for the promotion and protection of marine fisheries. Member states may grant regulatory management authority to the commissions.
- Regional Fishery Management Councils—Under the 200-mile law, the Regional Fishery Manage-

[39] U.S. Congress, Office of Technology Assessment. *Establishing a 200-Mile Fisheries Zone.* Washington, D.C., Government Printing Office, March 1977.

[40] From B. J. Rothschild and C. E. Meleky, paper, "Coastal Belt, Uses and Needs: Fisheries," Conference on Management of Coastal and Ocean Resources, University of Rhode Island, June 1977.

Table 3–7—Duties of Regional Councils and National Marine Fisheries Service [1]

Regional Councils	Department of Commerce (NMFS)
Determine information, data, and analysis needed to prepare management plans.	Prepare preliminary management plans for fisheries.
Test and evaluate techniques for determining optimum yield and other management factors.	Issue permits for foreign fishing.
Secure needed information from NMFS or other regional sources as necessary to complete management plans.	Establish general regulations and guidelines for preparation of all management plans.
Prepare fishery management plans, oversee their implementation.	Provide the Councils with data and information necessary to prepare management plans.
	Work with Coast Guard on enforcement of regulations.
	Work with State Department to determine national allocations of the total allowable level of foreign fishing.

[1] Source: Adapted from Office of Technology Assessment, *Establishing a 200-Mile Fisheries Zone,* March 1977.

ment Councils may make recommendations concerning fish stocks in the territorial sea, but without enforcement power.

- State-Federal Fishery Management Program—these programs are jointly developed, and NMFS assists and advises the States in cooperation among themselves on the management of important interstate marine resources. This program includes interstate fisheries that exist inside and outside the territorial sea (although most are within the territorial sea). Funding for the development of such management is available; however, no specific legislative authority exists for this program.

While the patterns for fishery management appear to be set in the 200-mile zone, effective State-Federal management for the fisheries in the territorial sea requires the integration of the resources of the individual States, the Interstate Marine Fisheries Commissions, the Regional Fishery Management Councils, and the State-Federal Fishery Management Program.

Current Fishery Policies and Problems

Marine Recreational Fishing

The Federal role in marine recreational fishing is typical of the general picture with respect to the national government's general approach to ocean matters:

- Role identification;
- It is fragmented and without an overall policy body ensuring that disparate activities are coordinated (see chapter IX);
- There is potential for Federal-State conflicts; and
- Disagreements exist over the extent to which one recreational fishery should be supported over another and between sport and commercial interests.

The evident need is for Federal efforts to be evaluated both for whether they might be as well or better handled at another level of government and for their impact on other species and interests as well as the general environment.

A partial list of Federal agencies with activities bearing directly on marine recreational fishing includes:

- The Army Corps of Engineers, whose harbor breakwater and jetty projects are open to anglers;
- The Forest Service, over whose jurisdictional lands two-thirds of the anadromous species (for example, salmon) travel during their lifetime;[41]
- The Department of the Interior, which has several organizations involved, including the Fish and Wildlife Service and its habitat purchase and protection programs, the National Park Service with its National Seashores, the Heritage Conservation and Recreation Service and its assistance in park purchases and overall State recreation planning, and the Bureau of Land Management and its public land holdings;
- The Environmental Protection Agency and its mission to clean up the Nation's waters and wetland protection;
- The Coast Guard and its boating safety mission; and
- NOAA's National Marine Fisheries Service, which absorbed the marine game fish functions from Interior at the time of its formation in 1970. Its marine recreation activities include: research to understand species, information to help protect certain species, information to assist anglers, statistics, and economic analysis.[42] Also under NOAA, the National Weather Service provides marine weather forecasts, and the National Ocean Survey provides charting information among other data.

A number of specific Federal acts affect recreational fishing; some also affect commercial fishing as well, but the motivation is often for the recreational fishing interests. Typical is the Anadromous Fish Conservation Act of 1965 (P.L. 89–304), aimed at bolstering a dwindling supply of salmon in the northwest. Under this authority, NMFS in 1976 was spending $6 million to induce enlarged salmon runs and the Fish and Wildlife Service was spending an additional $11 million. The Fish and Wildlife Service claimed its expenditure would result in $50 million in economic value for commercial interests and $360 million for recreational interests.[43] The Fishery Conservation and Management Act includes recreational fishing where allocations of a particular fishery include a share for recreational users.

The major assistance program in support of recreational fishing is the Dingell-Johnson Act of 1950, the counterpart of the 1937 Federal assistance program for helping with the purchase of wildlife refuges, the Pittman-Robertson Wildlife Restoration Act. To date, the Dingell-Johnson program has made available $204.5 million to the States on a matching basis for both freshwater and marine fishery research, habitat protection, and management. With the funds, States have acquired 96,687 acres of ter-

[41] U.S. Comptroller General, op. cit. note 4, p. 56.

[42] U.S. House of Representatives. "Department of State, Justice and Commerce, the Judiciary and Related Agencies, Appropriations Hearings, Fiscal Year 1978." Washington, D.C., Government Printing Office, 1977, p. 206.

[43] U.S. Comptroller General, op. cit. note 4, p. 56.

ritory, some of which are in marine and estuarine areas.[44]

These efforts on the part of the Federal Government to encourage and sustain marine recreational fishing, matched by State efforts toward the same end, lead to one of the major issues raised by recreational fishing: What is the value of this activity relative to commercial fishing? Table 3–8 lists a host of species of fish sought by both recreational and commercial fishers on all coasts.

The competition for fish coupled with growth of saltwater angling as a leisure activity has heightened the conflicts between recreational and commercial interests. The number of people in recreational fishing has grown from 6.2 million in 1960 to 9.4 million in 1970 and to an estimated 16.4 million at the present.[45] The increasing number of people buying licenses for recreational fishing sometimes leads to pressure in the States to restrict commercial taking of fish valued for recreation. Sometimes the result is to ban commercial harvest or to apply equipment restrictions that curtail commercial activity.

Among the many examples of recreational-commercial conflict is the anchovy in California. It is caught commercially for fishmeal and is used as bait in recreational fishing. Further, the anchovy is an important source of forage for many species of interest to recreational fishers. The argument came down to whether the commercial take should have been allowed to increase beyond a level of 242 million pounds in 1974. NMFS said the catch could be increased without harm. California State fish and game officials and recreational fish interests opposed an increase, because anchovy is food for a number of game fish.[46]

Situations such as this place the Federal Government squarely in the middle of what can be bitter disputes. The present regulations are for the most part promulgated by State governments, certainly for activity within the 3-mile territorial sea; however, the

[44] George H. Siehl, Analyst, Congressional Research Service, Library of Congress.

[45] John V. Merriner, Virginia Institute of Marine Science. Paper at Marine Recreational Fisheries Conference, New Orleans, February 27, 1976. Sport Fishing Institute, Washington, D.C., p. 123.

[46] U.S. Comptroller General, op. cit. note 4, p. 23.

Table 3–8—Fish species sought by recreational and commercial fishers [1]

Atlantic and Gulf Coasts

Oceanic region	Northeast Atlantic: Maine to New York	Mid-Atlantic: New Jersey to North Carolina	South Atlantic: South Carolina to Florida	Gulf of Mexico
Offshore: beyond 3 miles	cod, pollock, porgies, haddock, boston mackerel, bluefish, blackfish, flounders, hake, ling, whiting, swordfish, tuna, sea bass	swordfish, tuna, boston mackerel, bluefish, cod, hake, haddock, whiting, flounders, sea bass, pollock, porgies, ling, blackfish	snappers, groupers, king mackerel, swordfish, grunts, porgies, bluefish, tuna, flounders, sea bass	groupers, snappers, tuna, king mackerel, grunts, sea bass, bluefish, dolphin fish
Inshore: shore and small-boat fishing out to 3 miles	blackfish, bluefish, striped bass, hake, flounders, smelt, shad, whiting, sea bass, white perch, weakfish	weakfish, porgies, croakers, spot, spotted weakfish, shad, striped bass, bluefish, blackfish, white perch, sea bass	sea bass, grunts, channel bass, blackdrum, weakfish, spotted weakfish, flounders, pompano, groupers, snappers, croakers, striped bass, shad, white perch, spanish mackerel	channel bass, blackdrum, spotted weakfish, flounders, sea bass, groupers, snappers, cobia, spanish mackerel, bluefish, grunts

Pacific Coast

Oceanic region	South Pacific: Southern California	Mid-Pacific: Northern California to Canada	Alaska
Offshore	yellowtail tuna, mackerels, sea bass, rockfish, snapper, ling, albacore, bonito	cod, black cod, ling, rockfish, albacore, flounders, salmon, sea-run trout, halibut	salmon, cod, rockfish, halibut, flounders, sea-run trout
Inshore	rockfish, sea bass, flounders, surf perch, opal eye, striped bass, shad, corbina, corvina, ling	striped bass, shad, salmon, sea-run trout, surf perch, opal eye, flounders	halibut, salmon, sea-run trout, cod, rockfish, flounders

[1] Source: U.S. Library of Congress, Congressional Research Service, George Siehl, "Recreation and the Coastal Zone," Washington, D.C., Library of Congress, September 8, 1977, p. 9.

Pacific Fishery Management Council has a plan for the anchovy which allows a moderate expansion of the commercial fishery.

The different approaches taken by State governments cause the consternation of recreational and commercial fishing people alike. Under the Fishery Conservation and Management Act, the Federal Goverment has a role in attempting to bring about more uniform regulations on the taking of individual species.

Differences in State regulations abound. For instance, Georgia, New Jersey, New York, and South Carolina regard the striped bass (rockfish) as a game fish and prohibit its catch in nets. North Carolina encourages a major commercial fishery for striped bass. South Carolina restricts recreational catches to 10 per day; North Carolina has no limit. For the same species on the West Coast, California has a limit of three per day for recreational anglers, and Oregon, five.

Conflicts arise between recreational and commercial fishing interests. An example occurs in Narragansett Bay, R.I., where some anglers complain about the size of the commercial menhaden catch, saying it deprives striped bass and bluefish of food and thereby cuts into the catch of those species.

In a case such as described above, one Federal role is to provide accurate information about the size of menhaden stocks and the amount that might be caught without damage to other stocks. State officials decide what limits to set with the Federal Government seeing that the State decision does not have any adverse implications from a national standpoint.

According to some fishery scientists, compounding the problems of recreational vs. commercial fishing interests is inadequate information about many species on which better decisions need to be made. (This same situation holds true for implementation of the 200-mile law, but the practicalities require the Regional Councils to make the best judgments they can with available data.) There appear to be problems with the statistics involved. Commercial data are generally considered underestimates of actual landings, according to at least one account, whereas recreational data are said to be high. For instance, the head of the Sport Fishing Institute developed figures for recreational catches in 1970 that came to one-half of those of another researcher (Deuel),namely 0.8 billion pounds vs. 1.58 billion pounds.[47]

The Federal Government's multiple activities in support of marine recreational fishing appear to be another area calling for an objective, overall examination of what disparate agencies and departments are doing, with an eye to spotting the duplicative or conflicting programs and those which could be transferred to State or local governments. It is also an area where the Federal-State relationship has elements of conflict.

The presence of the Regional Councils to implement the Fishery Conservation and Management Act, with a legislative mandate to enhance and protect recreational, as well as commercial fishing interests, is seen as a hopeful new tool for bringing about greater Federal coordination and smoother cooperation between Federal and State officials.

[47] Ibid, p. 126.

Increasing Fishery Productivity

In addition to the management and conservation efforts that were set into motion by the Fishery Conservation and Management Act of 1976, there are several other activities which could increase the domestic share of the world's commercial landings and revitalize the fishing industry. These activities include:

- restoration of depleted stocks;
- reduction of foreign competition;
- possible development of underused species;
- increased efficiency with improved techniques and technology—harvesting, product handling, processing, storage, and marketing; and
- development of aquaculture.

Restoration of Depleted Stocks

Although extended jurisdiction has the effect of significantly reducing foreign competition for fishery stocks in U.S. waters, the principal intent of this legislation is, as its title suggests, management and conservation. Because management is, to a large degree, planning for the future, a large part of the management effort is concerned with the enhancement of stocks that are now or are soon to be depleted.

Besides aquaculture and the development of new genetic stocks, the various techniques used to enhance a particular stock include:

- limiting harvests—as manifested by optimum yield levels which are recommended by the Regional Fishery Management Councils;
- supplementing stocks—improving the health and viability of particular stocks by adding individuals; and
- maintaining or improving environmental quality near fishery habitats—improving the water quality in areas vital to marine fisheries such as estuaries, rivers, and coastal areas, and the construction of artificial reefs.

Reduction of Foreign Competition

Competition from foreign fishing operations involves two components: competition over the stocks within a particular fishery and competition from imports. The Fishery Conservation and Management Act of 1976 gives domestic fishing operations preferential rights to harvest the stocks within the U.S. fishery conservation zone. While foreign catches in the conservation zone have been on the decline since 1972, implementation of the Fishery Conservation and Management Act further reduced foreign harvests in the zone.

A February 1978 NMFS draft report [48] proposed further reductions of foreign fishing activities in the conservation zone and subsequent replacement by U.S. vessels and crews. In this way NMFS estimates that U.S. fishing fleets could harvest 2.1 million tonnes of fish that were allocated to foreign operations. If this change were to occur, it would nearly double the present domestic landings, which have ranged from 2 to 2.5 billion pounds annually. It is expected that much of these landings will be of stocks that are not popular in the United States and will be exported to foreign markets. Such a change could help reduce the trade deficit in fish, which was $1.4 billion in 1974.[49]

A less drastic recommendation came from the General Accounting Office. It suggested that, because many other governments have instituted an extended fishing zone of their own which will affect the productivity of the U.S. vessels fishing in their waters, the United States should enter into reciprocal agreements with such countries desiring to fish within the conservation zone. The establishment of foreign fishing allocations is a first step toward reducing the competition from foreign fleets.

The other impact of foreign operations that affects the health of the domestic industry comes from imports. Title II of the Trade Act of 1974 designates the Department of Commerce's Industry and Trade Administration to provide direct loans as well as guaranteed and insured loans and to disseminate relevant technical information to firms seriously injured or threatened by imports that result from trade agreement concessions.

The Pacific Coast oyster industry has been jeopardized by imports and illustrates the problem in this area. According to the General Accounting Office, Korean imports of canned, smoked, steamed, boiled, and frozen oysters increased 60 percent from 1972 to 1973. There was a fear that imports of canned products alone under a bilateral agreement with the Republic of Korea could lead to the downfall of the domestic industry along the Pacific Coast.[50]

A number of species such as Alaska pollock are caught by foreign fleets in the U.S. Fishery Conservation Zone and subsequently imported by the United States, either fresh or frozen. Imports would certainly be reduced if domestic fleets landed the stocks that foreign fleets now harvest from domestic waters, yet it is not clear that this would be an economical move. These species are not always the ones landed by present domestic fleets—therefore, the situation could call for new boat techniques and processing plants—all requiring major capital investment. This in turn, could mean higher prices to the U.S. consumer.

Competition from imports is another issue. It is possible for foreign imports to underprice domestic products for several reasons, of which the principal are:

- less expensive labor,
- low overhead, and
- government subsidization.

These elements of foreign trade are not unique to the fishing industry, but there are aspects peculiar to fisheries. U.S. law requires that before a vessel can engage in coastwide trade or fisheries of the United States, it must be under the U.S. flag and must have been constructed in the United States. For a few fisheries, such as tuna and shrimp, U.S.-built ships are preferred over all others. Because U.S.-built ships are often considerably more expensive, as much as 30 percent higher, than those built elsewhere, the high overhead cost for the vessel increases the price of the product at the market.[51] While the gap between the cost of foreign- and domestic-built boats has been closing recently, the construction of larger, more expensive vessels to harvest deepwater bottomfish could cause this issue to intensify. In contrast, U.S.-built shrimp vessels are exported widely.

Because of the expense of new fishing boats and the small size of most fishing operations, there is a general reluctance to make major investments unless they are absolutely necessary. As a result, the fleet has a large number of old boats. In 1974, Coast Guard records showed the average age of fishing boats was nearly 22 years.[52] Older boats have a difficult time competing with newer, more efficient boats of foreign fleets.

Domestic fleets pay more for fishing gear than their foreign counterparts. The import duty on nets and netting materials is nearly 50 percent. Whereas this serves as an effective deterrent to U.S. purchase of foreign nets, it also serves to raise artificially the price of the domestic nets. There is some irony in elements of the fishing industry who want controls on imports

[48] U.S. Department of Commerce, op. cit. note 15.
[49] U.S. Comptroller General, op. cit. note 4.
[50] Ibid.
[51] Ibid.
[52] Ibid.

of fish, but reduced restrictions on imports of fishing gear.

Developing Underused Species

The common property nature of marine resources is part of the problem concerning the harvesting of species which now may be underused. Compared with the large risks involved, an investor willing to sponsor the harvest of underused species can realize only a minimal economic gain, because there is nothing comparable to patents or "leases" on fisheries.

Beyond this major disincentive, a number of other problems hamper the development of underused species:

- need for resource surveys and assessment to determine if there are, in fact, underused species and their extent;
- possible new harvesting techniques and technology;
- different techniques for storage, processing, and product development; and
- need for marketing and economic analysis.

Table 3-9 notes some underused stocks that have potential for development.

Table 3–9—Underused stocks in U.S. waters with potential for development [1]

Species	5-year average catch 1970–74	5-year average catch 1971–75
	million pounds	
California anchovy (central stock)		222
Pacific hake (offshore stocks)	0	
Atlantic herring (offshore stocks)	37	
Round herring		0
Jack mackerel		36.6
Skipjack tuna (central and western Pacific)		11.0
Atlantic squid (short-fin and long-fin)	3.3	
Croaker	16.4	
Mullet		33.1

[1] Adapted from U.S. Controller General, *The U.S. Fishing Industry—Present Condition and Future of Marine Fisheries.*

Resource Surveys and Assessments

Although the NMFS Marine Resources Monitoring Assessment and Prediction Program (MARMAP) functions primarily to supply the information required to manage and conserve the fishery resources, this program can collect data on the abundance and location of possible underused stocks as well.

The NMFS Fishery Engineering Laboratory has been involved in developing new techniques for such surveys. This laboratory is at NASA's National Space Testing Laboratory in Bay St. Louis, Miss. The development of satellite and aircraft survey techniques has been facilitated by this arrangement. Satellite assessments may some day be able to predict the location of schools of certain species of fish with high accuracy.

Harvesting Techniques and Technology

There are questions about the role that government should play in the development of techniques and technology which can be used commercially. Present policy directs NOAA's research and development efforts at improving techniques for harvesting fish which are designed strictly to contribute to a better understanding, conservation, or use of the fishing resources. Occasionally, this work can lead to developments with commercial application.

Storage, Processing, and Product Development

Several possible underused species with economic potential, such as mullet or Pacific hake, are more perishable than most varieties. Changes in methods of shipboard handling and storage will have to be made to handle such fish. With support from the Sea Grant program, one such development has emerged. Researchers have found that when mullet are dipped in sodium ascorbate, their rate of decay can be slowed down significantly. They feel that further improvements in this area will aid the development of a productive mullet fishery. At the present time, the short storage time has been a major obstacle to expansion of this fishery.

Research sponsored at the University of Rhode Island has shown that New England squid have a tremendous economic potential either for export or home consumption. Americans are not inclined to use squid as are Europeans and Asians, but the development of canned and frozen squid could have a future market here. Food scientists and engineers at the Massachusetts Institute of Technology (MIT) have designed and built a prototype of a squid eviscerating and skinning machine.

MIT engineers also have begun a 2-year study to devise an automated process to remove the skin of the spiny dogfish shark. There are two constraints on the development of this fishery: first, the common name of the fish and second the high cost of manually removing the leathery skin. Stocks of spiny dogfish shark are abundant within U.S. waters, but are little used at the present. This project is part of the Gloucester fishery revival project discussed above.

Another possibility is the use of wastes from harvesting and processing as new food sources for humans and as feed for animals. The Food and Agriculture Organization of the United Nations estimates that as much as 8 billion pounds of trashfish is discarded by shrimpers who catch 8 to 20 pounds

of trashfish per pound of shrimp caught.[53] Shrimp boats now do not have room to store these low-valued species. Techniques for storing and processing such fish, which are normally thrown back dead, would aid the development of underused species.

Marketing and Economic Analysis

A study currently underway is examining the potential foreign markets for fish and shellfish that exist in commercially harvestable numbers in U.S. waters, but are not now tapped by domestic fleets. The study, expected to be completed by October 1978, is primarily supported by NMFS and the Economic Development Administration. Additional support comes from funding contributed by Federal Regional Commissions. Preliminary estimates indicate that new export markets could be valued as high as $10 billion.

An important aspect of market development with regard to possible underused species is consumer education. The increasing concern with human nutritional requirements could help the acceptance of newly introduced species. One problem in developing future markets of some underused species is that many carry unappealing names—such as cancer crabs, rat tails, and spiny dogfish sharks. Food and Drug Administration regulations require that fishery products be labeled with their common names.

NMFS has begun a project concerning market names for fishery products, basing the name on edibility characteristics such as color, texture, flavor, and fat content. The uniformity of this system should help consumers shop on the basis of edibility preferences. In addition, it is hoped that these names will have more appeal than many of the common names of underused fish.

Another marketing technique used by the Gulf and Southeast Fisheries Development Foundation to teach consumers about underused fish is to prepare a cookbook for these species. This effort was done in conjunction with other major marketing promotions.

Seafood Waste Recovery

Several projects are looking at the recovery of seafood processing waste for its nutrient value. Not only do these developments have the potential to bring about the more efficient use of the fishery resources, but by transforming processing wastes, such as shells, into commercially valuable products, the research can help eliminate the growing problem of waste disposal.

A private firm has developed a process which retrieves the "dust" resulting from sawing blocks of frozen fish. This byproduct, estimated to total as much as 10 percent of the frozen block, can be used as fish sticks or fillet-shaped products.

A project at the NMFS Fisheries Engineering Laboratory is attempting to develop a selective shrimp trawl that will prevent most of the incidental catch of low-valued trashfish.

Under Sea Grant's Seafood Science and Technology program, the University of Washington's "Total Utilization Concept" for fishery raw materials involves the completion of the processing cycle where use is made of byproducts and wastes in sequential processing stages.

Fishery Cooperatives

There have been some attempts to pull together the presently fragmented commercial fishing industry. The formation of the New England Fisheries Development Program in 1973 and the Gulf and South Atlantic Fisheries Development Foundation in 1976 could help regional fishery development. These groups coordinate many functions and serve as:

- a formal mechanism through which the commercial fishing industry of the region can identify its research and development needs,
- an institutional arrangement which allows fishery-related funds to be combined in order to accomplish defined objectives, and
- a potential advisory body to the appropriate Regional Fishery Management Councils.[54]

The New England Fisheries Development Program's original goal was to expand the value of fish production by $10 million by the end of 1978 by developing long- and short-finned squid, offshore crabs (red, Jonah, and rock), ocean quahogs, and mussels. This goal has been realized.

Since its charter in the fall of 1976, the Gulf and South Atlantic Foundation has contracted projects totaling over $150,000, generating over $750,000 in matching funds.[55]

Another cooperative program is the Pacific Tuna Development Foundation. This group is specialized and rallies around the common interest in the economic improvement of the tuna fishing industry in the Central, Western, and South Pacific. Funding for this group comes from the NMFS Saltonstall-Kennedy funds and the Pacific Islands Development Commission.

Aquaculture

Aquaculture is to fishing as agriculture is to hunting and gathering; the culture or husbandry of aquatic animals or plants, however, lags far behind agricultural advances. One authority estimates that

[53] Ibid.

[54] A Program for the Development of Underutilized Demersal and Pelagic Finfish Resources of the Southeast; Gulf and South Atlantic Fisheries Development Foundation, Inc., Tampa, Fla.

[55] Ibid.

U.S. aquaculture today is about where agriculture was 300 years ago, "very low in technology, but very high in promise and opportunity." [56]

Several reasons account for the lack of development of this activity; the most significant is simply that the need did not exist. Coastal fishing people, following the patterns passed on by family and community, learned the skills needed to harvest the ocean's living resources.

Aquacultural methods have some basic technical problems that need to be worked out before wide-scale development will be practical, especially the high incidence of disease that afflicts culturing pools.

Nonetheless, aquaculture does play a significant role in providing fish for the world. Nearly 10 percent of the world catch (13 billion pounds) comes from aquaculture facilities.[57]

NOAA's Aquaculture Plan, published in May 1977, noted that several species showed promise for increased expansion, including oysters, rainbow trout, and salmon. Table 3–10 contrasts the 1973 domestic aquaculture harvest with NMFS's projected 1990 harvest.[58]

Table 3–10—Aquaculture development for the United States—1973 totals and 1990 potential

	1973	1990
	—million pounds—	
Salmon	61	245
Oysters	20	200
Catfish	48	120
Trout (freshwater)	30	70
Shrimp	.5	63
Crawfish	10	30
Clams	2.6	25
Mussels	—	25
Lobster	—	10
Trout (seawater)	—	10
Abalone	—	5
Scallops	—	5
Pompano	—	3
Other	5.5	400
Total	177	1,211

[56] U.S. House of Representatives, Committee on Merchant Marine and Fisheries, Kent Price. Aquaculture Hearings before Subcommittees on Fisheries and Wildlife Conservation and the Environment and Oceanography. Washington, D.C., Government Printing Office, March 15, 1977.

[57] U.S. Comptroller General, op. cit. note 4.

The demand for fish in the Japanese diet has stimulated improved techniques of rearing and breeding in aquaculture. It is estimated that the Japanese government spends 10 times as much as the United States on aquaculture research and subsidy.[59]

A July 1977 NMFS document [60] identified species as candidates for aquaculture development (table 3–11).

Since that document was prepared, the Food and Agriculture Act of 1977 designated the Department of Agriculture as the lead agency for the development of aquaculture. The ramifications of this assignment are as yet unsure. The Department of Agriculture now has plans to develop the scientific, technological, and marketing bases for freshwater species only, such as catfish and trout. The 1977 Act gives Agriculture the legal authority for all aquaculture activities, but the development of marine aquaculture (mariculture) is and could continue to be the responsibility of both the Departments of Commerce and Interior.

Table 3–11—Species groups included in the aquaculture Implementation Plan

Fishes:	Anadromous: Pacific and Atlantic salmon, trout, striped bass Marine: Pompano, mullet, rabbit fish, threadfin, tuna bait fish, etc. Freshwater: Catfish, trout, carps, perch, buffalofish, etc.
Crustaceans:	Marine shrimp, freshwater prawn, lobster, freshwater crawfish, crabs
Mollusks:	Oysters, clams, scallops, mussels, abalone
Other:	Marine baitworms

[58] Ibid.

[59] Ibid.

[60] NMFS, draft, "Proposed Addendum for Implementation Plan—Department's Marine Fisheries Program for the Nation, July 1977.

Federal Support of Fishery Research

In the past, Federally supported fishery research has been fairly extensive and has concentrated on developing basic biological information about individual species.

A survey of Federal fishery research done in 1973, compiled by NOAA, found nearly 1,500 projects in the general field of "nonhuman living systems" by eight departments and agencies. Table 3–12 summarizes the survey.

In addition, the Departments of Agriculture and Transportation reported a few projects. Beyond this, fishery research is conducted by States and universities.

NOAA alone spends on the order of $40 million per year in fishery research. The figures for fiscal years 1974, 1975, and 1976 were $35.9 million, $41.9 million, and $44.5 million, respectively. The General Accounting Office study of the fishing industry in 1976 was not able to produce an overall figure for Federal fishery research activity, an indication that possible duplication exists.

Table 3-12—Fishery research projects [1]

	Commerce	National Science Foundation	Environmental Protection Agency	Health, Education, and Welfare	Smithsonian Institution	Interior	Energy [2]	Defense	Total projects
	numbers								
Mollusks-crustaceans	144	54	13	42	29	1	1	7	291
Fish populations	176	13	—	—	7	36	1	1	234
General ecology	95	50	42	1	6	10	15	2	221
Microorganism-plankton	48	100	27	6	7	3	3	13	207
Productivity-biochemistry	53	46	10	19	2	6	19	1	156
Other animals	29	40	1	9	31	1	—	15	126
Fish habitats	41	5	8	—	2	16	5	—	77
Plants	22	30	8	2	7	1	1	3	74
Fish physiology-biochemistry	25	13	3	14	—	7	1	—	63
Total:	633	351	112	93	91	81	46	42	1,449

[1] Source: U.S. Comptroller General, *The U.S. Fishing Industry—Present Condition and Future of Marine Fisheries.* 51 pp.
[2] Formerly Energy Research and Development Administration.

For a description of Federal marine research in general, which includes mention of the fishery-related activities, a 1977 publication of the Committee on Atmosphere and Oceans of the Federal Coordinating Council for Science, Engineering, and Technology provides the most recent information. Its title is "Guide to Information on Research in Marine Science and Engineering," [61] and it describes briefly the current fishery research of eight agencies and departments.

Despite the sizeable effort over the years in fishery research, the data base apparently is not sufficient for today's needs. In some eyes, this condition is because much of the research effort has not been sufficiently directed at stock assessment—which is critically needed in management decisions—but rather at more esoteric or basic biological science. The contrasting view is that it is precisely this basic biological research that is fundamental for sound stock assessments and, therefore, solidly based decisions on harvest quotas, moratoria, or season length, for instance.

According to a study made by the Congressional Office of Technology Assessment (OTA), fishery research has two major problems at present. One is the possible inadequacy of stock assessment information to meet today's management responsibilities, including inadequate testing of existing information in real-world situations. The other is an absence of reliable socioeconomic data on a variety of elements of the fishing industry.

Basic to the possible inadequacy of stock assessment information is the nature of the resource being studied—it is simply not possible in some cases to obtain accurate population counts before harvest. This is especially true with regard to species which inhabit the ocean bottom (groundfish). Reported the technology office: "(because of the difficulties) assessment must depend upon inference, statistical probabilities and the measures developed to understand the complicated and interrelated marine environment." [62]

With the adoption of the fishery conservation zone, intense pressure has been put on the Regional Councils to have accurate information on the size of the fishery stocks they are charged with managing. Too low quotas bring protests from foreign or domestic fishing interests; too liberal limitations could endanger the future health of the species.

OTA has stated that no stock of fish in the U.S. fishery conservation zone had the completely developed information base desired for management decisions.[63] This Congressional advisory unit listed the following characteristics of a completely adequate base of data on which sound fishery management should be based: [64]

- an understanding of species-stock biology,
- quantification of the commercial indices which allow trends in abundance to be followed,
- survey information demonstrating changes in stock abundance and age composition,
- survey information giving prerecruit indices,
- age and size composition data,
- historic catch and effort data,
- an understanding of movements and migrations,
- knowledge of the effects of factors such as temperature and water quality, and
- knowledge of the interrelations among species.

[61] Prepared by Office of Ocean Engineering, NOAA, Rockville, Md., May 1977.

[62] U.S. Congress, Office of Technology Assessment, op. cit. note 39, p. 77.
[63] Ibid., p. 78.
[64] Ibid.

The last element, information on the interrelations among species, is felt to be one of the major shortcomings of past research efforts which tended to focus on individual species. It is also felt to be critical to the types of management decisions that have to be made by the Regional Councils to implement the 200-mile law.

In addition to improving the accuracy and coverage of stock assessment data, there is also a requirement of the 200-mile law for expanded socioeconomic data. This is so in part because the determination of a stock's optimum yield, the stated objective of any management plan, turns on certain economic and social factors. Included among these are considerations of costs and returns, pricing, and regional employment. Also required will be information on the economics of foreign fleets operating in U.S. waters. Additional information needed about foreign fishing activity is the extent of investment by overseas interests in U.S. vessels and packing plants and the effect of these investments.

One aspect of current fishery management that needs to be studied is the trend, and the reasons behind it, for U.S. vessels being registered in foreign nations. From fiscal years 1971 through January 1977, a total of 1,200 U.S. fishing vessels were transferred to foreign owners or foreign flags.[65]

OTA identified seven areas of economic information for which NMFS was collecting inadequate data. The proposed remedy was a 10-year, $3 million-per-year effort directed at assembling accurate information on the following topic areas: vessel inventories, vessel construction costs, costs and earnings data, demand analysis data (from household surveys), employment data, fishery development, and recreational fishing impacts.

A recent review of social-science research in the marine field as a whole, including fisheries, but covering the entire range of marine matters, found much activity from the Federal standpoint centered in the NOAA Sea Grant program. Specifically, a committee within the Interagency Committee on Marine Science and Engineering reported in December 1976 that there were 304 marine-related social science studies between 1970 and 1975; 270 of them were by Sea Grant. Total cost for the 5 years was $10.9 million; See Grant contributed $7.2 million of this total.

In a report of its fishery activities, the Office of Sea Grant found 12.7 percent of its total project funding in 1977 went to fishery research—144 projects at $5.2 million. By category, the research projects, generally conducted at universities, were: resource development (23 percent), economics/legal (13 percent), environmental (13 percent), and technology (8 percent). Education and training consumed 3 percent of the funding, and the NOAA marine advisory service 41 percent.[66]

[65] Ibid., p. 82.

[66] Paper by Naida Yolen. "The National Sea Grant Program in Fisheries." National Sea Grant Office, NOAA, Washington, D.C., January 1978.

Fishery Management and Enforcement

The task in fishery management is that of allocating the common property resource, fish, among a number of claimants. This obviously calls for intervention by government into the fishing process.

This was explained clearly in the Senate Commerce Committee report accompanying the 200-mile legislation in 1975: [67]

> "Resource management is essentially a series of allocations—allocations among present users, allocations between present and future users, allocations between public and private interests. There are simply not enough fish to go around and the line must be drawn somewhere. . . . It is a fact of life that not everyone who wishes will be allowed to fish for a given stock of fish."

It is a surprise to no one that implementing the Fishery Conservation and Management Act has proven controversial. The difficulty of allocating the optimum yield per species among, first, domestic fishing people, and then among foreign nations, is considerable.

The purpose of Federal marine fishery management, which today means implementation of the Fishery Conservation and Management Act, is the attainment of what is termed the "optimum yield" of each fishery. The term means the amount of fish that will provide the greatest overall benefit to the United States with particular reference to food production and recreational opportunities, and is prescribed as such on the basis of maximum biological sustainable yield from such fishery, as modified by any relevant economic, social, political, or ecological factor.

As spelled out in the 200-mile law, management measures must, among other things, be based on the best scientific information available, be indiscriminatory between residents of different States, and wherever possible, manage a stock of fish throughout its full range, even if it crosses jurisdictional lines.

One management technique which is particularly controversial is limited entry into particular fisheries

[67] U.S. Senate, Committee on Commerce. Report 94–416, "Magnuson Fisheries Management and Conservation Act," Washington, D.C., Government Printing Office, October 7, 1967, p. 30.

in the name of efficiency. The aim here is to cut down the capital and labor employed in harvesting the common property resource and thus to avoid waste. Limited entry means curbing the amount of fishing effort allowed.

To succeed, limited entry could mean some who now fish in a particular fishery would no longer be allowed to, or at a minimum, no additional effort would be allowed beyond that now taking place. At the same time, most limited entry proposals contemplate a transition period or some form of "grandfathering" to accommodate present operators. The Fishery Conservation and Management Act explicitly permits the Regional Councils to recommend, among other approaches to fishery management, systems of limited entry according to certain specifications. One explanation of the purpose of this approach is as follows: [68]

> "The primary purpose of this technique is to reduce the congestion and economic waste that occurs from the open access condition of common property fisheries. Limiting access would also greatly facilitate the management of many fisheries by reducing the number of vessels being regulated."

Three different methods for limiting entry are generally prescribed. Licensing is one method of setting limits on the number of vessels, fishers, and nets or other devices allowed. Another method is a system of fees set high enough to discourage the casual fishing effort. And a third way to limit entry is to divide an allowable catch into quotas to be distributed among the participants.

Attempts to limit the present level of fishing effort under the 200-mile bill have proven controversial. The following excerpts from an article on the first year's experience with the 200-mile law in the *Gloucester* (Mass.) *Daily Times* [69] illustrate the point:

> "Upon its passage in 1976 and again when it became effective last year, the law was almost universally applauded by New England fishing interests. . . . The past year has been filled with some obvious pluses, some minuses, problems, power struggles and a few ironic twists no one anticipated . . .
> "The unexpected surge in landings led to low prices that made some fishermen complain bitterly that life had been better when the foreign fleet was around; landings were lower, prices were higher.
> "The low prices accelerated landings and led to rapid closures of the fisheries. The closures, in turn, prompted the New England Fishery Management Council to recomend relaxation of strict rules.
> "Handling of the recommendations by the Department of Commerce led to disputes with the council that have yet to be resolved as both groups struggle to assert and maintain their control over fisheries policy.
> "While the struggle continued, officials agreed to relaxed quotas that allowed for overfishing. Combined with massive landings from boats flaunting (sic) the rules, the combined catches for the year far exceeded acceptable biological levels, and instead of finding the stocks in better shape this year, the haddock, cod and flounder populations declined.
> "Strict catch limits have been mandated again for this fishing year (1978), annoying offshore fishermen who insist that there is plenty of fish and the biologists are wrong in saying they are mostly immature fish . . . Late last year fishermen learned just how serious the government was about enforcing the new law. Repeated warnings were made that fines of up to $25,000 per offense could be assessed to those exceeding the cod and haddock limits.
> "Many ignored the warnings, openly flaunting the law in the absence of immediate penalties . . .
> "Shortly before Christmas, the notices began to trickle out of marine fisheries service computers in Washington. Just as they had been warned, fishermen were being fined up to $25,000 per offense, a total of $150,000 in the case of one multiple violator.
> "More than 80 citations were issued, forcing many of the violators to band together in their own defense while those who abided by the rules were jubilant that the violators were finally being punished."

The situation described in Gloucester gives some suggestion of the difficulty in instituting a system of limited entry, especially without the full support of the industry.

The State of Alaska has experimented with limited entry with higher license fees. The experience there is being closely watched to see if it is successful and possibly applicable in other areas.

Other management techniques are available and, in fact, come under the heading of "traditional" approaches to fishery management. As summarized in a Senate Commerce Committee document circulated

[68] U.S. Senate, Committee on Commerce. *Fishery Management Under a 200-Mile Jurisdictional Limit.* Washington, D.C., Government Printing Office, 1975.
[69] *Gloucester* (Mass.) *Daily Times,* March 1, 1978, page 1.

at the time the 200-mile bill was before the Senate, these methods include the following:

- Closed seasons for a given species for a certain time.
- Closed areas, such as spawning or nursery areas where catches would endanger the future of the stock.
- Size limits, as with prohibition of smaller sized fish to enable them to mature and reproduce in order to ensure the future of the fishery.
- Vessel limits, as with restrictions on size, tonnage, or power in order to decrease fishing pressure on a stock by mandating a certain amount of inefficiency. This kind of limit is difficult to control, because even with limits on size and engines, improved gear can enable a larger-than-intended catch.
- Prohibitions on certain efficient types of gear. Sometimes this can be a restriction designed to protect the incidental catch of species.
- Catch limits. The difficulty here, as shown in the example below, is that the larger, more efficient boats tend to absorb as much of the quota as early as they can. The increase in efficiency of tuna vessels has meant a shortening of the tuna season in the Pacific from 9 to 3 months, for example. (This is the method selected this year by the New England Regional Council to enforce its cod quotas; on a quarterly basis, the catch is assessed and when the limit is hit, the fishery is closed. This method, especially in winter, favors the larger vessels, to the dismay of the small-boat owners.)

The requirements of the Fishery Conservation and Management Act are creating a number of demands. One of the principal demands is for more and better focused research data. Another is for an examination of the "traditional" approaches to fishery management as well as the "limited entry" concept for their implications on both the fishery stocks and on the fishery community.

The 200-mile law calls, in short, for something approaching a systems approach to managing the resources, where in advance of making decisions the repercussions are thought through, discussed with those who will be affected, and adjusted accordingly.

The three principal problems identified by the General Accounting Office in its review of fishery management up to 1976 were:

- the common property nature of the resource,
- fragmented jurisdiction, and
- lack of precise data.

The 200-mile law addresses in part the problem of fragmented jurisdiction. Backers of the law hope that it will soon stimulate acquisition and analysis of the precise data felt needed in order to manage effectively the Nation's fishery resources. The common property nature of the resource remains as the basic fact of life with which the Regional Councils must grapple in their attempts to balance competing demands on the resource.

The last major problem in fishery management is protection of the marine environment. (See chapters IV and VI.)

Law enforcement policy raises numerous questions. Initially, the approach taken in a fishery management plan and the language of the associated regulations themselves are factors in determining policy. The effectiveness and cost benefits of a given level of enforcement activity, both dockside and at sea, require continual scrutiny and evaluation. There are two major governmental considerations. The first is between Federal and State officials, as previously mentioned: A close working relationship among State agencies and the Fish and Wildlife Service, Coast Guard, and NMFS is essential. The second consideration is the cooperation of the Federal agencies in fishery management within the 200-mile zone. The Coast Guard and NMFS share equal responsibility with respect to Fishery Conservation and Management Act (FCMA) enforcement. Because of its established presence and capabilities, the Coast Guard is most active in the offshore area. NMFS is the principal enforcer of FCMA at the dock.

The Department of Justice supports the fishery management program as it represents the national interests through the judicial process, whereas the Department of State monitors and takes an active role in any endeavor involving foreign nationals and vessels.

Methods of attaining effective enforcement are always studied for improvement. Though the number of patrol ships and areas of patrol activity change, the basic approach of "at-sea" law enforcement is continuing to be the Coast Guard cutter's boarding party, supplemented by surveillance from ship and aircraft. Remote sensing devices and satellites are possibilities, though the present state-of-the-art and cost factors present severe limitations. Use of observers on board foreign vessels has been effective not only in terms of enforcement, but in collecting data for fishery management as well.

It is anticipated that the Coast Guard may have to increase "at-sea" inspections of domestic vessels to ensure their compliance with applicable management plans. The effectiveness of dockside inspections is limited in the enforcement of restrictions on fishing areas and methods (gear). Cost effectiveness of existing and proposed enforcement methods is being examined on a continuing basis to ensure optimum use of the resources and the appropriate level of enforcement. Generally, enforcement of fishery management regulations on domestic fishing operators poses serious problems.

Consumer Education and Product Quality

Successful market development rests on the consumer's satisfaction with the delivered product. This is clearly an obstacle to the development of underused species where different tastes and textures are not readily accepted.

Built into consumer satisfaction is the integrity of the product—consistent quality. Because fish are highly perishable, the need for quality control is essential.

Unlike the mandatory inspections of meat and poultry by the Department of Agriculture, there are no similar mandatory requirements for fish and fish product inspection despite the recommendation for such requirements by the "Eastland Survey" and the National Plan for Marine Fisheries. What does exist is a voluntary inspection performed by NMFS. These inspections are done at the request of, and paid for by, the processors and distributors desiring to assure the quality of their product and hoping to improve sales, because their items carry a Federal seal of approval.

It is to be noted, however, that merely requesting an official inspection does not guarantee approval of the products. If a processing plant does not meet the approval of the inspector, it may be closed down until the problem, usually one of sanitation, is resolved.

At the present time, Federal inspectors handle only 3 percent of the domestic fish processing plants and 30 percent of U.S. processed fishery products. This is not to suggest that the remaining fish go unchecked before they are marketed. The Food, Drug, and Cosmetic Act designates the Food and Drug Administration (FDA) to assure that all food, including fish and shellfish and products derived from them, involved in interstate commerce is safe, pure, wholesome, and processed under sanitary conditions. Furthermore, the Act, as amended, requires that imported seafood products attain these standards as well. FDA fulfills this responsibility by using a screening approach—periodic spot checks on domestic processing plants and selected lots of imported fish and fish products—before they are brought into the United States for sale and distribution. Like FDA inspectors in other parts of the food industry, they usually arrive without warning and collect samples for laboratory analysis.

The fish and fish products not subject to Federal law or regulation are those stocks, such as gamefish, which are consumed in the same State they are caught and processed, hence not involved in interstate commerce.

Situations do arise where Federal guidance is appropriate at the State level. The recent contamination of the James River, Va., with kepone is such a case.

In a related function, NMFS is involved in research on environmental contaminants that are prone to accumulate in fish and are maintained in the processed product as well. Contaminant constituents include: organic, such as PCBs; heavy metals, including mercury and lead; and petroleum and petroleum products.

The NMFS Seafood Quality and Inspection Division administers the voluntary inspection program and also promulgates standards and specifications for sanitation, grade identity, and nomenclature for fish and fish products. In their entirety the categories for these standards are the components which make up quality—the concern of the consumer.

Chapter IV: Coastal Resources

Introduction

The region bounded by the shorelands, estuaries, nearshore ocean, and the Great Lakes is referred to as the coastal region. As the place where the land meets the sea, this region is recognized as a unique geographical unit deserving special consideration to protect its environment and enhance its usefulness.

Awareness of the importance of the coastal region was aided by three Government-sponsored studies published in 1969 and 1970. The first was the report *Our Nation and The Sea,* compiled by the Stratton Commission and released in January 1969.[1] The Commission recommended the enactment of a "Coastal Management Act," which would provide financial and technical support for States to encourage better use of coastal resources. The other two studies were made by the Department of the Interior and published in late 1969 and 1970. In the first of these reports, the Interior Department recommended legislation similar to that proposed by the Stratton Commission and stressed the effects of pollution on the estuaries and interrelations between the activities that take place on land and the impacts that occur in the coastal waters.[2] The second Interior Department study documented the effect of man-induced activities on estuarine areas.[3]

The Coastal Zone Management Act of 1972 was approved October 27, 1972. Since that time, national awareness of the importance of the coastal region has been raised by events associated with the accelerated development of oil and gas on the Outer Continental Shelf, siting of energy facilities both onshore and offshore in the coastal region, deepwater port proposals, oil spills, nearshore ocean dumping, contamination of estuaries, and increasing recreational pressure on the shoreline.

The roots of the Nation's history are in the coastal region. Most major population centers are on or near the coasts. Continued economic expansion attracts increasing numbers of people to many of these metropolitan areas. The abundance of cooling water and the proximity to centers of heavy energy usage make the coastal region ideal for siting nuclear and fossil-fueled powerplants. Offshore oil and gas deposits contain the major remaining reserves of domestic oil and gas apart from Alaska; in addition, imported petroleum, which makes up nearly one-half of present domestic consumption, enters through ports and is refined, processed, and transported in and through the coastal region. Increased volumes of imported liquefied natural gas (LNG) are anticipated to meet projected shortfalls of domestic natural gas, thus requiring further expansion of energy-processing facilities in the coastal region. The coastal region also attracts chemical industries, which depend on petroleum feedstocks, and heavy industry, much of which is closely linked with ocean-borne transportation. In the present absence of acceptable land-based disposal methods, coastal communities and industries turn to the near offshore areas for disposal of sewage and industrial wastes.

On the other hand, the coast is a unique recreational resource. Its attractions bring millions of transient vacationers to the beaches from the interior of the country. Recreational fishing takes about 800,000 tons of fish a year from coastal waters. Coastal attractions lure second-home developments, condominium high rises, marinas, and supporting services.

Because the coastal region represents many different things to many different people, the public rarely considers the coasts as an entity. The concept of a coastal region or coastal zone may be sound scientifically, but it is unrecognizable to the general public in a functional sense. The public at large is affected by specific instances such as oil on the beaches or sewage driven ashore by winds and currents. Likewise, the closing of shellfish beds because of pesticide

---

[1] Report of the Commission on Marine Science, Engineering, and Resources to the President of the United States and the U.S. Congress, by Julius A. Stratton, Chairman. *Our Nation and The Sea—A Plan for National Action.* Washington, D.C., Government Printing Office, 1969. A more detailed treatment is given in the Panel Reports of the Commission. Volume 1, Science and Environment, Part III, Report of the Panel on Management and Development of the Coastal Zone. Washington, D.C., Government Printing Office, 1969, III-1 to III-187.

[2] U. S. Department of the Interior, *The National Estuarine Pollution Study.* Washington, D.C., Government Printing Office, 1969.

[3] U.S. Department of the Interior, *National Estuary Study,* Washington, D.C., Government Printing Office, 1970.

or fecal contamination, or the presence of mercury in pelagic fish, directly affects the public. These incidents of environmental pollution are perceived as discrete occurrences, and are seldom seen as part of a matrix of man-induced uses that accumulate over time.

This chapter (1) describes the physical, socioeconomic, and demographic characteristics of coastal regions; (2) discusses the Coastal Zone Management Act of 1972 (CZMA) in terms of its provisions and the basis for regulatory power over coastal uses; (3) assesses the status of the States' participation in the coastal management program; and (4) reviews planning and regulation of specific uses of the coastal region for wetland protection, coastal recreation, energy facility siting, offshore and onshore power generation, and offshore mining.

The Coastal Region

The coastal region, in a generic sense, is the comparatively narrow band of land and ocean waters that bounds the periphery of the Nation. It includes, by definition, estuaries and embayments that are infused by freshwater from the discharge of inland rivers. Included are the Great Lakes—the inland seas, which have problems of resource use and protection similar to the seaward boundaries of the Nation. The U.S. coastal region extends 88,000 miles along the Atlantic, Gulf, and Pacific Coasts; another 11,000 miles along the shores of the Great Lakes; and 2,500 miles along the island perimeters of Hawaii, Guam, Puerto Rico, the Trust Territories, and Virgin Islands.[4] In this region where ocean use and land use interact there is special need to protect the valuable natural features, to allocate the mutually dependent land and ocean resources, and to resolve the conflicts among competing uses.

Physiographic Characteristics

The physical setting, as much as any other factor, determines the use capability of the coasts, and hence, the kind and extent of development. In the northern coastal regions, where glaciation was severe, the coastline is rugged, steep, and indented by fiordlike embayments that are rimmed with craggy rocks and have a narrow intertidal area. To the south where present coasts were once covered by the ocean, the coastal plain is flat, incised by numerous rivers and shallow embayments that form extensive estuaries, and fringed by wide beaches and broad intertidal margins. Here, where freshwater and saltwater constantly mix, are extensive tidelands and wetlands.

In Alaska, along the Bering and Chuckchi Seas, the tundra meets the ocean to form a unique segment of continental margin. The coasts of Hawaii are of volcanic origin and significantly different than mainland coastal systems. Guam, the Trust Territories, and the Virgin Islands are in tropical waters, and coral geology influences their coastal regions.

All coastal areas change continuously. The effects of erosion, wave action, and sediment deposit continually alter the shape of the coast in gradual and sometimes dramatic ways. Barrier islands along the Atlantic and Gulf Coasts are continually molded as sand is eroded and moved laterally. Storms occasionally split land areas and form new islands. The natural processes of accretion, avulsion, and erosion influence man's use of the coastal margin. In turn, man's activities can severely modify and alter the natural processes of coastal dynamics.

The coastal ecosystems that have developed within these physiographic regions are products of the topography, geochemistry, and the climate. The viability of each ecosystem depends upon maintaining the balance among these components. Hence, any factor which tends to disrupt the natural equilibrium of the environmental complex can cause changes in the physical and biological characteristics. The sensitivity of natural systems to change varies considerably over the range of the coastal margin. Five coastal features are particularly vulnerable to alteration or disturbance: (1) tidelands and wetlands, (2) islands, (3) dunes, (4) estuaries, and (5) coral reefs.

Tidelands and Wetlands

These coastal lands are covered periodically by saltwater. Wetlands are usually vegetated with grasses, sometimes with mangroves. In the upper regions of certain bays, saltwater wetlands merge with freshwater wetlands. Nearer the ocean, the wetlands undergo periodic tidal washes. The vegetation in these areas plays a key role in the food chain of the adjacent estuarine system. Dead leaves and organic matter are broken down into small particles (detritus), which are the energy source for a variety of marine life, including juvenile fish and shellfish.

A more detailed discussion of wetlands, their

[4] Panel Reports, volume 1, op. cit. note 1, p. III–7.

role, and attempts to regulate their use, appears in the section "Protection of Coastal Wetlands."

Islands

Within the United States are an estimated 26,325 islands greater than 10 acres in size.[5] Alaska contains much of the acreage in the Nation's island estate—with over 6,000 islands accounting for 21 million acres of the 28.6-million-acre total. The other 20,000 islands contain 7.5 million acres.

Islands are extremely susceptible to damage, particularly on the Atlantic and the Gulf Coasts where barrier islands protect the mainland from storms and waves. These islands are noted for their broad beaches and natural beauty, which attract recreationists and developers. The instability of the islands, which tend to gain and lose area through natural processes, makes them vulnerable to storm damage. Barrier islands are invaluable because they, rather than the mainland shores, absorb the shock of offshore storms.

Attempts to stabilize barrier islands have proven futile, as demonstrated by the National Park Service's (NPS) efforts on the Outer Banks of North Carolina. For years, NPS attempted to stabilize the narrow, sand islands that separate the ocean from large bays. It recently announced its discontinuance of efforts to stabilize the islands and acknowledged that it is inevitable that the barrier islands will change shape because of winds, waves, and storms. The Army Corps of Engineers has also become more reluctant to embark on large projects for shoreline stabilization.

The value of the Nation's barrier islands was highlighted in President Carter's environmental message on May 23, 1977, in which he noted that 68 barrier islands remain in relatively unspoiled condition.[6] However, many of the islands are privately owned and subject only to the normal controls imposed by the States and the Federal Government, such as wetland regulations or dune controls. In many instances, private ownership and privately controlled developments serve to preserve the island habitat by restricting general public access.

Dunes

Similar to barrier islands offshore, dunes serve to protect inshore areas from storm waters. Deposits of beach sand form a berm that stabilizes the encroachment of grasses and xeric plants. The dune system on a barrier island consists of two parallel lines of dunes. The oceanside dune is the first line of storm defense and is most susceptible to change from natural processes. The secondary landward dune line grades into forested areas inland.

Because these windrows of stabilized sand are important to the protection of the inland area, the alteration of dunes by construction or as the result of the gradual destruction of the stabilizing plants can lead to serious consequences. Wholesale destruction of dune vegetation has resulted from excessive use of vehicles and trampling by animals and humans. In addition, because of their location on high ground overlooking the beach, dunes are prime areas for residential and commercial development.

Estuaries

Estuaries are the mixing zones between the saltwater of the ocean and the freshwater carried by inland tributaries. It is a zone of enrichment and is highly interactive chemically and biologically. Estuaries are distinguished from bays and embayments by the degree of enclosure and the characteristics of the physical processes occurring within. Clark has suggested that estuaries, to be classified as such, must have a shoreline length in excess of three times the width of its outlet to the sea.[7]

The distinguishing feature of estuaries, however, is their role as a mixing area for fresh- and saltwater. Fresh inland water carries nutrients, sediments, minerals, organic matter, and contaminants. The interface of fresh- and saltwaters is highly productive, and, coupled with the influence of the adjacent wetlands, creates a rich and diverse ecosystem. Estuarine waters are often shallow and thus permit penetration of sunlight through a rich photosynthetic layer. Such conditions produce large amounts of plankton and benthic organisms that serve a vital role in maintaining the food chains of finfish and shellfish. It is estimated that within their life cycles three quarters of the domestic commercial fish at some time live in the Atlantic and Gulf estuaries.

Estuaries are nursery areas for a number of fish species. Among these are pink shrimp of the Gulf of Mexico, channel bass, striped bass, bluefish, croakers, mackerel, and menhaden. Destruction of the wetlands, reductions in inflow of freshwater, excessive sedimentation, or pollution of the estuarine system by toxic substances impair the productivity of the ecosystem, thereby affecting fish populations and commercial and recreational harvest. Thus, the estuarine environment may be damaged by events that occur at great distances inland or at the head of tributaries. Estuarine systems generally are resilient to environmental damage, yet thresholds can be exceeded with disastrous effects. The greatest threat may be the chronic degradation of the estuarine environment through the cumulative impacts of pollution and gradual alteration of the adjacent wetlands.

[5] U.S. Department of the Interior, *Islands of America.* Washington, D.C., 1970, p. 6.

[6] U.S. Office of the President. *President's Environmental Message,* May 23, 1977.

[7] John Clark. *Coastal Ecosystems.* Washington, D.C., Conservation Foundation, 1974, p. 2.

Coral Reefs

Coral reefs are among the most unique marine ecosystems. Formed by the skeletons of living animals, coral reefs are important to the marine systems of Guam, Hawaii, the Trust Territories, Virgin Islands, and the southern extension of Florida. They are easily damaged by contamination from sewage, erosion from runoff, chemicals, or waters of high temperatures. Silt from dredging operations near coral reefs can smother the living coral, thereby impeding its growth or killing it. Although not extensive in range, coral reefs are of immense benefit to the coastal regions where they are found. They afford cover for fish and sedentary species which form the coastal fisheries of tropical marine ecosystems and serve as storm barriers for adjoining mainland areas.

Economic Activity

The economy of the coastal region is based upon diverse income-producing activities which range from extractive industries, agricultural enterprises, and manufacturing to services, transportation, and the retail trade. It is a microcosm of the national economy, but is skewed toward ocean-related uses. The uses of the coastal region fall into six basic categories: (1) living space and recreation—perhaps the consequence of, rather than the cause for, economic activity, although they cannot be separated; (2) industrial and commercial activities—including ports, power production, mining, and commercial development; (3) waste disposal—frequently the final resting place of unwanted industrial and domestic wastes; (4) food production—largely fishing, but also including land-based agriculture; (5) natural preserves—wetlands and waterfowl preserves; and (6) special government uses—portions of the coastal zone which are used for military and civil activities that require a coastal location for security or operational reasons.

The coastal conference sponsored by the Woods Hole Oceanographic Institution and the Institute of Ecology in 1972, from which the report *The Water's Edge—Critical Problems of the Coastal Zone* [8] was produced, discussed the more important economic activities in the coastal region. The conference noted that commercial fishing in 1970 was a $600 million industry, with 45 percent of the catch taking place in nearshore waters.[9] Marine sport fishing was estimated to add an additional $800 million to the economy, based on 1965 data.[10]

Among the nonrenewable resources considered, offshore oil and gas was then yielding 18 percent of the oil and 15 percent of the natural gas recovered in the Nation and was projected to go significantly higher.[11] Sand and gravel extracted from beneath coastal waters was valued at $100 million annually.[12] Recreation, the conference reported, was the leading economic activity in the coastal region. In 1968 it was estimated that about 112 million people participated in a total of 7.1 billion ocean-oriented occasions and spent about $14 billion for the experience.[13] The report noted further that 40 percent of the industrial capacity of the Nation was in the coastal region as defined by the estuarine counties, which cover 15 percent of the total land area.[14] The conferees were unable to assign a total value to housing, energy production, transportation, and waste disposal.

In 1973, a conference on "The Oceans and Economic Development," sponsored by the National Oceanic and Atmospheric Administration, stated that 43 percent of the industrial work force was in the coastal region, which was defined as the coastal counties excepting Hawaii and Alaska.[15] This figure represented a growth of 4 percent in the period 1940–70. Growth slowed after 1960, and a small decline was noted in 1970 (table 4–1).

A comprehensive attempt to arrive at the economic value of ocean-related activities was performed by Nathan Associates for the Congressional Research Service at the request of the Senate National Ocean Policy Study in 1974.[16] Although the study dealt with all ocean resources generally, the findings apply to a subset of coastal activities as well.

Nathan Associates cautioned in the report that estimates of economic value in many cases should be considered as only "a rough order-of-magnitude indication of economic value," because "relevant information is frequently scanty or non-existing." [17]

The value of the domestic fisheries industry, including processing and marketing, had risen to $2.2

[8] Bostwick Ketchum. *The Water's Edge—Critical Problems of the Coastal Zone.* Boston: MIT Press, 1972, p. 13.
[9] Ibid., p. 45.
[10] Ibid., p. 86.
[11] Ibid., p. 66.
[12] Ibid., p. 70.
[13] Ibid., p. 89
[14] Ibid., p. 107.
[15] U.S. Congress, Senate, Committee on Commerce. *The Oceans and the National Economic Development.* Washington, D.C., Government Printing Office, 1973.
[16] U.S. Congress, Senate, Committee on Commerce. *The Economic Value of Ocean Resources to the United States,* by Nathan Associates. Washington, D.C., Government Printing Office, 1974.
[17] Ibid, p. 1.

Table 4–1. Percentage of total U.S. industrial employment in the coastal zone [1,2]

Portion of coastal zone	Percentage of land use	Percentage of U.S. industrial employment			
		1940	1950	1960	1970
New England	0.50	4.00	3.78	3.68	3.60
Mid-Atlantic	.85	15.45	15.29	15.18	14.29
South Atlantic	.94	1.15	1.39	1.94	2.15
Eastern Gulf Coast	.77	.62	.76	1.03	1.08
Western Gulf Coast	.88	1.54	1.72	1.91	2.11
Southern California	.57	2.75	3.54	4.89	5.29
San Francisco area	.37	1.73	2.21	2.62	2.83
Northern California-Oregon	.80	.20	.27	.28	.27
Washington	.63	.84	1.00	1.03	1.09
Great Lakes	2.24	10.77	10.88	10.31	9.85
Total coastal zone	8.58	39.05	40.84	42.88	42.57
Coastal zone less Great Lakes	6.34	28.28	29.96	43.57	32.72

[1] Coastal zone is defined as the set of counties contiguous to the oceans or the Great Lakes or their estuarial arms. Alaska and Hawaii are omitted.

[2] Source: U.S. Congress, Senate, Committee on Commerce. *The Oceans and National Economic Development.* 93d Cong., 1st sess., Committee Print. Washington, D.C., Government Printing Office, 1973, p. 168.

billion by 1972 and was projected to reach $1.4 to $4.2 billion in fish value alone by the year 2000 (processing and marketing are additional).

The mineral industry is the largest, and destined to grow larger, in terms of ocean resource production. Dominated by the production of oil and gas offshore, mineral production was $3.4 billion in output in 1973. By 1985, the amount is expected to reach $15.8 billion. In addition to oil and gas there was projected production of significant amounts of magnesium and sulfur. Deep-ocean mining is expected to constitute a $130 million extractive industry by 1985, and processing onshore would add several hundred million more dollars to the industry's value. Ocean transportation of goods, both foreign and domestic, was said to constitute a $10.5 billion private investment in 1972.[18]

The Nathan report suggests that offshore energy production will become a major economic factor in coming years, projecting an investment on the order of $3.7 to $6 billion in the year 2000. This is primarily offshore nuclear power production, but could be higher if conventional plants are located offshore.

Population

In terms of demographic trends, the "coastal States" are by and large "growth States;" and the "coastal counties" within those States are growth areas; thus the metropolitan areas near the coast are, for the most part, expanding. The Nation's 12 largest States have coasts,[19] and 9 of the 12 fastest-growing States, in terms of percentage growth, are coastal States.[20]

Coastal counties within these States are generally growth counties. Most of them expanded in population between 1960 and 1970 at a rate that exceeded the national average of 13.3 percent. On the West Coast, for example, in the 46 coastal counties that stretch from Washington to California, 30 grew faster than the national average during the period 1960–70, 11 had growth rates below the average, and only 5 reported a net loss in population. Where population losses were reported during the decade, they tended to concentrate in the southeastern counties of Texas, several counties in Georgia, South Carolina, North Carolina, Virginia, and in the southernmost counties of Maryland.

The concentration of people in metropolitan areas is clearly in the coasts (fig. 4–1). By the year 2000, it is projected that about 45 percent of the citizens living in metropolitan areas will be within 100 miles of the East Coast, 16 percent in the Gulf and 30 percent on the West Coast.[21]

Population statistics for the "coast" are subject to both definitional and statistical ambiguities. The basic census tracts are defined by either county (or parish) units in the rural areas, and the Standard Metropolitan Statistical Area (SMSA) for cities and their suburbs. The county and SMSA census tracts can distort the population statistics because they are

[18] Ibid, pp. 93.

[19] In order, California, New York, Pennsylvania, Texas, Illinois, Ohio, Michigan New Jersey, Florida, Massachusetts, Indiana, and North Carolina. U.S. Census Bureau, *Characteristics of the Population.* Washington, D.C., Government Printing Office, 1970.

[20] In order (noncoastal States in italics), *Nevada,* Florida, *Arizona,* Alaska, California, Maryland, *Colorado,* Delaware, New Hampshire, Hawaii, Connecticut, and Washington, ibid.

[21] U.S. Congress, Senate, Committee on Commerce, op. cit. note 16, p. 39.

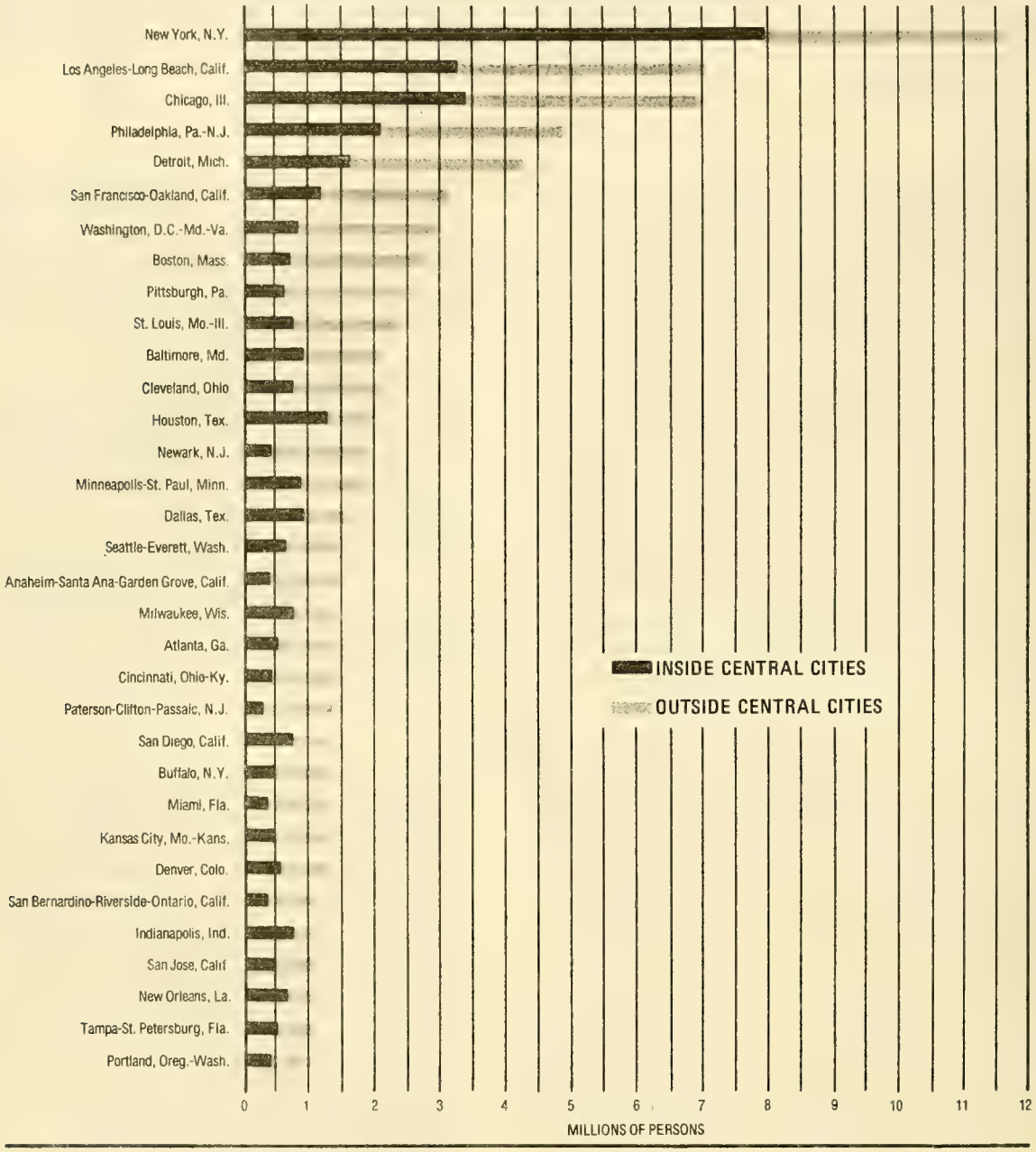


Figure 4–1.—Standard metropolitan statistical areas of 1 million persons or more, 1970 (ranked by size). Source: 1970 U.S. Census of Population, U.S. Department of Commerce, Bureau of the Census.

geographical entities that do not conform neatly to the definition of "coastal."

The definition of coastal itself is ambiguous with regard to the identification of population patterns. To designate a State, county, or SMSA as a "coastal" unit suggests a degree of involvement with coastal or Great Lakes waters. Traditionally the "coastal region" has been considered to extend inland as far as the effects of the ocean tide can be detected. This makes Washington, D.C., a "coastal city" because the tide affects the Potomac River as far as the old port city of Georgetown, a section of Washington. But to residents of the Washington area, the city is hardly coastal; the coast in any real sense is a 3-hour drive to Rehoboth, Del., or Ocean City, Md. There is a similar situation involving Houston, Tex. About 40 miles inland, the city is classified as coastal because of its connection to Galveston Bay by the Houston Ship Channel. But Galveston, a city on a coastal island, is more clearly the "coastal" city than its larger neighbor Houston.

It is often stated that "more than one-half the people in the country live within 50 miles of the coast." The statement is misleading because it is based upon census figures which indicated that in 1970 "about 53 percent of all . . . people now live in counties which lie *at least partly* within 50 miles of the Nation's coastlines," [Emphasis added.][22] Therefore, people residing more than 50 miles from the coast are included in the county statistics making up the census totals. Six hundred counties have a portion within 50 miles of the coast; only 400 actually touch the coast. On the other hand, there are counties which touch the coast and are included in "coastal" population statistics, but extend far inland. Jefferson County in the Florida panhandle is one such case.

The 400 counties included in table 4–2 (at end of chapter) are considered to be coastal by NOAA's Office of Coastal Zone Management, drawn from program submissions by the States. The final list will probably be smaller, because States have initially selected larger coastal planning areas than will be included in their final definition of the coastal zone under their coastal management program. Thus, Washington State listed 17 counties in the initial list compiled by its coastal zone office and 15 in the final definition of its coastal territory.

The population in the 400 counties designated by the State's coastal programs was 85,489,421 in 1970, or 42 percent of the Nation's population of 203.3 million. By contrast, 107 million persons lived in the Census Bureau's list of 600 "coastal" counties.

Coastal Zone Management

Background

The concept of coastal zone management developed in the late 1960s in response to the accelerating use of coastal resources. Pressures from industrial, commercial, and residential users were growing. The judgment was that the existing governmental apparatus to deal with such pressures—Federal, State, and local—was inadequate. "Something must be done," concluded the Stratton Commission in its chapter on Management of the Coastal Zone.[23]

Our Nation and The Sea, released at the time the Nixon Administration took office in 1969, was one of at least five sources that identified the need for a revised system of decision-making about future uses of the coastal region. Similar recommendations came from the Marine Sciences Council, a Cabinet-level council headed by the Vice President; from the estuary studies prepared by the Department of the Interior in 1969 and 1970—the National Estuary Study and the National Estuarine Pollution Study; and from the recommendations of the American Law Institute (ALI) for a Model Land Development Code.[24]

The concept of coastal zone management, and other forms of land-use planning and resource regulation that have been proposed, is predicated on the police powers that reside in the sovereignty of the States. In the past most States have delegated this inherent power to municipal and county governments. While some State constitutions transferred these policy powers to the local governments, most States enacted enabling statutes to execute the transfer of zoning power. Piecemeal planning and the failure of local zoning and regulatory authorities to exercise coordinated control over the coastal region contributed to the stated need for comprehensive planning and regulation in the coastal region. The basis of coastal zone management was to be the recoupment of the State powers to control some uses of land and waters in the coastal margin, based on an areawide perspective that would transcend the fragmented boundaries of local government. A regional or interstate approach also was contemplated.

[22] U.S. Department of Commerce, Census Bureau, Press Release, Glenn M. Hearin, 29 November 1970.

[23] *Our Nation and The Sea,* op. cit. note 1 p. 49.

[24] The American Law Institute. *A Model Land Development Code.* Philadelphia, American Law Institute, 1971.

At least part of the motivation for centering a coastal management approach in State government was fear on the part of States that direct Federal involvement might be the alternative.

A number of coastal States, particularly those on the East Coast and the Great Lakes, had enacted single-purpose wetland protection laws to stem the loss of these areas to development and to reduce coastal erosion. Building on these initiatives by the States themselves, coastal zone management was to extend similar State controls to all coastal-related land use in a comprehensive manner. It was to be a general purpose program which would apply to all significant activities and all areas within the definition of "coastal zone," rather than single-purpose legislation or loosely coupled regulatory programs.

The coastal zone management approach represented a departure in one major regard from previous Federal programs. The program was to base its contols on a consideration of the coastal resource as an entity. That is, the policies which the individual States were to adopt were to be based on a reasoned look at the entire range of values contained in their coastal lands and waters. This comprehensive approach contrasts with customary single-use or single-resource regulatory programs.

The proposals for coastal management came at a time markedly different from today. The period when the concept of coastal zone management was conceived was at the height of the "environmental movement." It also coincided with the Santa Barbara oil spill of January 1969, an event which came at a time of increased public sensitivity to the natural environment, and through extensive media coverage, indelibly impressed the public as to the vulnerability of the coastal environment.

The oil spill added a sense of urgency to the issue of protecting coastal resources. The Stratton Commission had termed the siutation a "crisis." [25] The *National Estuary Study* sounded its own alarm: [26]

> "Estuaries are in jeopardy. They are being damaged, destroyed and reduced in size at an accelerating rate by physical alteration and pollution. They are favorite places for industry, which finds the land cheap, water transportation easy, and waste disposal convenient. They are also favorite places for residential developers who find it exceedingly profitable to dredge and fill an estuary, and thus destroy part of it in order to appeal to affluent Americans to live near the water in houses which are accessible by both boat and automobile."

The idea of a Federal grant-in-aid program to a State-level office to prepare and administer coastal zone management programs won broad support. The Nixon Administration initially endorsed the idea and introduced legislation. In testimony on December 3, 1969, Secretary of the Interior Walter Hickel testified: [27]

> "[The National Estuarine Pollution Study] concludes that our estuaries are seriously polluted and that the unwise use of the lands and waters of our estuarine zones not only contributes to this pollution, but is rapidly destroying valuable natural resources. While the statutory directive was to study the estuarine zones, the findings concluded that the management problems of our estuaries relate directly to the entire coastal zone, and that any management system must deal with the coastal zone, and its entirety."

There was near-unanimous agreement on the concept of a Federal coastal zone management program, although the National League of Cities objected on behalf of local governments.[28] The subsequent debate centered not on the merits of coastal zone management, but on whether the program should be in the Department of the Interior or the Department of Commerce and whether it should be a component of an overall national land-use program, which had also been proposed. The Nixon Administration endorsed the latter approach in opposition to a separate coastal program; during the Watergate period support for a land-use bill was withdrawn.

President Nixon approved the National Environmental Policy Act (NEPA) on January 1, 1970, and declared the coming 10 years to be the "environmental decade" in which the country would begin to make up for past misuse of the environment. Major additions to the Clean Air Act were approved in 1970. The Federal Water Pollution Control Act Amendments were approved in 1972. Legislation was enacted in 1972 placing curbs on ocean dumping in response to a public furor over poison residue disposal off the Atlantic Coast and other similar occurrences.

It was in this atmosphere that the Congress considered and enacted the Coastal Zone Management Act of 1972 (CZMA). The list of bills signed on the same day as the coastal management program indicates the national mood: Consumer Product Safety Act, Marine Mammal Protection Act, Noise Control Act, Ocean Dumping Act, and legislation establish-

[25] Panel Reports, volume 1, op cit. note 1, p. III-145.
[26] U.S. Department of the Interior, op. cit. note 3, p. 2

[27] U.S. Congress, House, Committee on Public Works, Testimony, December 3, 1969.
[28] U.S. Congress, Senate, Committee on Commerce. *Legislative History of the Coastal Zone Management Act of 1972, as amended in 1974 and 1976.* Washington, D.C., Government Printing Office, 1976, p. 381.

ing the Gateway National Recreation Area in New York, N.Y., and the Golden Gate Recreation Area in San Francisco.

Concern for the Nation's environment continues today; however its emphasis has been modified by other national priorities. Economic conditions, unemployment, and energy supply/demand have become the top priority items on the Nation's agenda since 1972. For instance, industries allege that environmental regulations are costing jobs, delaying the development of new energy supplies, and otherwise contributing to the recession of the mid-1970s. Enforcement of environmental laws has become increasingly difficult. Pollution control deadlines have been extended, and standards lowered in some cases.

Although The Coastal Zone Management Act was enacted at the apex of the environmental movement, its implementation spanned a period during which energy and economic problems have forced the Nation to restructure its priorities in a more pragmatic fashion. Some energy and economic problems led to increased pressures on the coastal regions.

The administrator of the Commerce Department's National Oceanic and Atmospheric Administration (NOAA), in reviewing a General Accounting Office report on the status of coastal zone management in 1976, stated: [29]

> "The political climate for programs perceived as environmental in their thrust and those which involve additional governmental intervention and regulation is much harsher today than when the Coastal Zone Management Act was passed four years ago. States with coastal zone legislation on the books at that time are now fighting to prevent repeal of that legislation. In no case has preexisting state coastal legislation been strengthened. Without doubt, passing new State coastal legislation today is a much more difficult task than the framers of the Coastal Zone Management Act of 1972 envisioned."

North Carolina illustrates the changing political climate in the States. The passage of the North Carolina Coastal Area Management Act in 1974 was seen as a landmark in the coastal zone management program.[30] Key to the North Carolina Act is the authority for a Coastal Resources Commission to name "areas of environmental concern," in which development would require either a local or State permit, depending on size. Such new development would have to be in accordance with a locally prepared and State-approved county coastal plan.

In 1977 the North Carolina Act came under serious attack in the State General assembly. The State Senate considered a bill repealing the coastal act. In the House a bill making major modifications to the basic act and curbing the authority to name "areas of environmental concern," was supported by the State coastal office as a compromise measure, and was adopted. The legislature adjourned with the State statute still intact.

Despite the harshness of the climate, coastal legislation has been enacted in a number of States such as Alaska, Alabama, California, Hawaii, Louisiana, and South Carolina. These acts have to be examined carefully to see how far they go toward being comprehensive State coastal acts. For instance, the 1977 passage of a State Coastal Act in South Carolina is cited as one of the current successes of the national program. The principal controls in the act are for a State permit system governing wetlands alteration. The Act also contains a provision countenancing suits against the State by individuals who feel they have a claim to shore areas down to the mean high tide line.

Coastal Zone Management Act of 1972 as Amended

National Policy

In enacting the Coastal Zone Management Act of 1972, the Congress identified five elements of national policy which form the basis for the Federal CZM program. They are: [31]

- to preserve, protect, develop, and where possible, to enhance, the resources of the Nation's coastal zone . . . ;
- to encourage and assist the States to exercise effectively their responsibilities in the coastal zone through development and implementation of management programs . . . ;
- for the Federal agencies engaged in programs affecting the coastal zone to cooperate and participate with State and local governments . . . in effectuating the purposes [of the Act];
- to encourage the participation of the public, of Federal, State, and local governments and of regional agencies in the development of coastal zone management programs; and
- to encourage cooperation among the various state and regional agencies, including the establishment of interstate and regional agreements, cooperative

[29] U.S. General Accounting Office, Report to the Congress by the Comptroller of the United States. *The Coastal Zone Management Program: An Uncertain Future.* Washington, D.C., Government Printing Office, 1976, p. 101.

[30] For an account of the North Carolina experience, see "How North Carolina Came to Pass a Coastal Zone Act," *Marine Technology Society Journal* 8 (10), p. 9.

[31] Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et seq.

procedures, and joint action particularly regarding environmental problems.

Thus, the objectives of the Act are to: (1) preserve, (2) protect, (3) develop, and (4) enhance and restore, where possible, the coastal resources. The mechanism to achieve these objectives is through "encouragement" and "assistance" to the States. Cooperation of the Federal agencies with the States is pledged to achieve the objectives of the Act. The general public is to be a participant in the development of coastal zone management programs. Interstate and regional approaches to resource management are encouraged.

Financial Assistance

The Secretary of Commerce is authorized to award annual matching grants to the coastal States for the purpose of assisting in the development of coastal zone management programs. Financial assistance is provided in three tiers according to the progress of the States in meeting the Federal guidelines:

- *Development Grants*—Section 305 of the CZMA authorizes the award of four annual grants, up to 80 percent, to the participating States to aid in preparing management programs. All of the coastal States (including the Great Lakes) and Guam, Puerto Rico, and the Virgin Islands have participated.
- *"305½" Grants*—Interim grant authority was provided in the Coastal Zone Management Act Amendments of 1976 (P.L. 94–370) to allow two additional grants to States that have completed the design of a management program, but require additional time to put it into effect. Two States received assistance under this provision through fiscal year 1977.
- *Administrative Grants*—Eighty percent grants may be awarded to States for the operation and administration of an approved management program that meets the requirements of the regulations and has been formally submitted and approved by the Secretary of Commerce, (Sec. 306). Three States—California, Oregon, and Washington—have been approved under Sec. 306 through September 1977—California's program is less than complete, because of a pending suit.

States may pass through a portion of their administrative grants to a local government, Statewide agency, regional agency, or an interstate agency to implement the State program with the approval of the Secretary of Commerce. Programs can be proposed for geographic segments of States. Strengthening of local planning efforts is one of the principal accomplishments cited by the Office of Coastal Zone Management in the 5 years of the program's existence. This comes about in States where pass-through funding has taken place. Otherwise the effect has been to strengthen to a degree the planning capability at the State level.

Coastal Zone Program Requirements

A coastal zone management program must have nine elements to meet the minimal substantive requirements under the Section 305 development grant process.[32]

- identification of the boundaries of the coastal management zone;
- definition and identification of land and water uses that have a significant impact on coastal waters and that will be permitted in the coastal zone;
- designation and inventory of areas of particular environmental concern;
- setting priorities for uses, especially those of regional, Statewide, or national significance, in particular areas of the coastal zone;
- establishing procedures and organizational structure for managing the coastal zone;
- identification of the authorities the State will use to exercise control over land and water uses;
- description of the State organizational structure that will operate the management program once it is approved;
- definition of "beach" and a planning process dealing with access to public coastal areas; and
- planning of processes for dealing with energy facilities and their impacts, and for dealing with coastal erosion.

The Coastal Zone Management Act was clearly intended by Congress to emphasize *control* of land and water use, and not mere *planning* without the capacity to implement the program and plans. The preamble of the CZMA [33] says that States should:

> ". . . exercise their full authority over the lands and waters of the coastal zone by . . . developing land and water use programs for the coastal zone, including unified policies, criteria, standards, methods, and processes for dealing with land and water use decisions of more than local significance."

To qualify for approval under the provisions of Section 306, a State program must meet five specific requirements:

- The State must have a coordinating mechanism with affected local governments, which must include provisions of a notice when a State decision would conflict with a local zoning ordinance and provide a 30-day comment period;

[32] Ibid., Sec. 1454(b).
[33] Ibid., Sec. 1541(h).

- The governor must designate a specific State agency to administer the program;
- The State must demonstrate that it has given, and will continue to give, adequate consideration of the national interest in siting such things as energy facilities, in order to prevent a State from arbitrarily barring facilities from its coastal region;
- Provision must be made for preserving or restoring particularly valuable coastal areas; and
- States must have selected one of the following three techniques for controlling land and water uses in the coastal zone: (1) establishment of criteria and standards at the State level for implementation by local entities, (2) direct State land and water use planning and regulation, or (3) State administrative review for consistency of any development within the coastal zone, with power to approve or disapprove.

In addition, the designated management agency must have authority to acquire property through condemnation if necessary to achieve conformance with the management program. State programs may be approved for geographical segments of the coast with the approval of the U.S. Secretary of Commerce in order to protect coastal regions that require immediate action.

Federal Consistency

To round out the coastal States' authority for regulating the use of land and water in the coastal zone, Section 307 of the CZMA provides a mechanism for ensuring that Federal projects and actions by the Federal agencies conform with approved State coastal zone programs.

Sections 307(c)(1) and (2) require that activities, including development projects, significantly affecting the coastal zone and conducted or supported by Federal agencies shall be consistent with approved State programs to the "maximum extent practicable."

Section 307(c)(3)(A) provides that Federal licenses and permits for activities significantly affecting land and water uses in the coastal zone may be granted only if the State certifies that the activity complies with and will be conducted consistently with its coastal zone program. This is perhaps the most significant consistency provision. Corps of Engineers' dredge or fill permits under Section 404 of the Federal Water Pollution Control Act Amendments and a number of Federal permits required for energy facilities in the coastal zone will be subject to this provision. Thus, the States have important leverage on Federally-registered private activities affecting the coastal zone, even if such activities are located outside the described zone.

Section 307(d) prohibits Federal agencies from approving State and local grant applications for activities significantly affecting the coastal zone that are inconsistent with the State's approved coastal zone management program. An activity for which a Federal license, permit, or grant is required is subject to the consistency provision, even though located outside the coastal zone, as long as the activity significantly affects the coastal zone. There are differences in interpretation of this section among Federal agencies.

The operation of these provisions combined with the financial support provided for developing and administering coastal zone programs are the principal inducements for States to participate in the coastal management program. Without the prospect of "Federal consistency," many Federal projects and actions would be beyond the control and regulation of the coastal States. Even with the consistency provision, a number of Federal activities may be beyond State coastal zone programs.

The U.S. Secretary of Commerce can override a State's finding of inconsistency with regard to a Federal license, permit, or grant, if it is found that the project is "necessary in the interest of national security" or that the activity is in fact "consistent with the objectives of this . . . [Act]." The implementing regulations attempt to confine the Secretary's override to situations where national interest or security concerns outweigh coastal management objectives. Furthermore, a specific exclusion makes it clear that the Act as a whole does not apply to "lands, the use of which is by law subject to the discretion . . . of the Federal Government." [34] Consistency does apply to activities on Federal lands which affect a coastal zone.

These variances, while necessary to preserve the flexibility of the Federal agencies to conduct business in the national interest, may seriously limit the control that States can exercise over Federal activities. They have, in fact, been described as "escape hatches." [35] Legal scholars have identified several problems with the "consistency" concept, and the legislative history of the Coastal Zone Management Act does little to clarify the precise way Congress intended its provisions to operate.[36] The legislative language of Section 307 is subject to wide interpretations, and those uncertainties probably will persist until defined by the courts.

Under the 1972 CZMA, there was uncertainty about the status of Outer Continental Shelf (OCS) oil and gas exploration, development, and production activities with respect to the consistency provisions. The Coastal Zone Management Act Amendments of 1976 appended special consistency provisions for these OCS oil and gas activities (Sec-

[34] Ibid., Sec. 1453(a).
[35] William C. Brewer, Jr. "Federal Consistency and State Expectations," *Coastal Zone Management Journal* 2, 1976, p. 322.
[36] Richard G. Hildreth. *Natural Resources Lawyer*. American Bar Association, 1977, p. 216.

tion 307(c)(3)(b)). The effect of the 1976 amendments was to expedite the determination of "consistency" by requiring a certification of consistency with State coastal zone management programs by the lease holder for any exploration, development, or production plan in the OCS. Concurrence by the State within 6 months is required, subject to an override by the Secretary of Commerce for national security reasons or based on a finding of substantial compliance with the objectives of the Act. If the State's objections are sustained, a revised OCS plan must be submitted under an abbreviated review schedule. If certification of consistency is accepted by the State without objection or if a State's objection is overridden by the Secretary of Commerce, any activity described in detail in the exploration, development, or production plan, and conducted in accordance with the plan can be carried out without further consideration by the State.

From the standpoint of the States and local communities, the detail of information in the OCS plans is key. If extensive, the State and communities can prepare to deal with the anticipated impacts. If information is sketchy, approval may be given to open-ended documents and control over the later implementation effectively waived once consistency is agreed to by the States. The Department of the Interior has attempted to deal with this potential problem in its regulations.[37]

Amendments to the Outer Continental Shelf Lands Act of 1953, being considered by Congress, clarify the relationship between coastal States and the Department of the Interior, which is the offshore licensing agent.

Coastal Energy Impact Program

Acceleration of OCS oil and gas development in the face of rapidly increasing oil imports has prompted the coastal States to seek additional funds from the Federal Government. The Coastal Zone Management Act Amendments of 1976 established a program of grants, loans, and bond guarantees under Section 308 of the CZMA. To qualify, States must be receiving Section 305 (development) or 306 (administrative) grants, or, in the Secretary of Commerce's opinion, be developing a management program "consistent with the policies and objectives of the Act (Sec. 303)."

Two interlocking forms of assistance are provided through the program: (1) a 10-Year, $800 million Coastal Energy Impact Fund, and (2) formula grants authorized at $50 million a year for 8 years.

Coastal Energy Impact Fund

This is a revolving fund established under Section 308(c) and (d) and is the primary source of assistance to coastal States and local governments affected by new or expanded coastal-dependent energy activity. The Fund is disbursed in five modes: [38]

- *Loans* to assist in providing new or improved public facilities and services made necessary by coastal energy activities;
- *Guarantee of bonds* issued by a coastal State or locality to obtain funds to provide new or improved public facilities and services required by coastal energy activities;
- *Repayment grants to meet credit assistance obligations* under a loan or bond guarantee in cases where the coastal energy activity involved failed to provide adequate revenues to offset the indebtedness.
- *Grants if a State suffers loss* of valuable environmental or recreational resources as a result of coastal energy activities, the cost of which cannot be attributed to or assessed against any identifiable source and cannot be paid for through other Federal programs; and
- *Grants to study and plan* for economic, social, and environmental consequences resulting from the siting, construction, and operation of new or expanded energy facilities in the coastal zone.

The U.S. Secretary of Commerce must allocate funds for loans and bond guarantees among the States according to: (1) employment and related population attracted to the State by new coastal energy activities and (2) standardized unit costs for public facilities and services.

Annual Formula Grants to Coastal States

Each State's formula grant is based upon the following proportion calculated from data of the previous fiscal year:

- *OCS acreage newly-leased* adjacent to a coastal State relative to the total OCS acreage newly-leased (one-third);
- *Volume of oil and natural gas produced* adjacent to the State relative to the total volume produced on the OCS (one-sixth);
- *Volume of OCS oil and gas first landed* in a State relative to all OCS oil and natural gas landed in all coastal States (one-sixth); and
- *Number of individuals in new OCS-related employment* relative to the total number of individuals who obtain new OCS-related employment in all coastal States (one-third).

The use of formula grants is restricted to: (1) retirement of State and local bond guarantees where there is an inability to repay, (2) prevention, reduction, or amelioration of unavoidable loss of a valuable ecological resource as a result of an energy

[37] See 30 Code of Federal Regulations Section 250.34 and 30 CFR Part 252.

[38] No more than $50 million of the total $800 million can be expended for planning and environmental grants.

activity if blame cannot be determined, and (3) planning for public utilities and services required by OCS activities *if* grants from the Coastal Energy Impact Fund are inadequate. Retirement of guaranteed bonds has priority in the expenditure of funds obligated under the formula grant program. Formula grants are intended to be a secondary source of funding for States and communities.

Implementation of the Coastal Zone Management Act

The Coastal Zone Management Act is an experiment in federalism. It involves an intricate pattern of intergovernmental relationships and a redistribution of political power among State, Federal, local, and regional governments. Within the States themselves, State and local interests can conflict; and, even among State agencies, differences in perspective and constituencies often result in disagreement. For Federal agencies faced with the prospect of having to accommodate State programs in the performance of their activities, the coastal zone management programs hold the possibility of delays, added expense, constraints as to what they see as their mandate under law, and additional administrative problems. As for interstate coordination or regionalization, the concept is highly touted, but regional governments or interstate agencies with adequate delegated authority are rare. These problems in implementating the CZMA are receiving increased attention from inside and outside the Federal Government.

Federal Agency Involvement

Federal agencies, other than NOAA's Office of Coastal Zone Management, are directly involved in administering the CZMA at two levels: (1) consulting, reviewing, and commenting on State programs prior to approval of an administrative grant under Section 306, and (2) complying with the Federal consistency requirements of Section 307 subsequent to approval of the State program. Complicating this review is the fact that regional offices first review State program documents and then the Washington headquarters does so; the views at the two levels are not always the same.

With regard to the first responsibility, the Secretary of Commerce is required to "consult . . . cooperate with, . . . and coordinate . . . activities with other interested Federal agencies," in carrying out the duties prescribed by the Act.[39] A State program cannot be approved "unless the views of Federal agencies . . . have been adequately considered." In the case of serious disagreement between Federal agencies and the State, the Secretary of Commerce in cooperation with the Executive Office of the President will mediate.

States are further constrained by the programs of the Federal agencies to the extent that the CZMA does not "diminish either Federal or State jurisdiction, responsibility or rights in the field of planning, development, or control of water resources, submerged lands, or navigational waters," nor can it affect an interstate agreement or interstate agency.[40] Similarly, the operation of the Federal Water Pollution Control Act and the Clean Air Act and their related State programs are to be coastal zone air and water requirements.

Although the Coastal Zone Management Act was approved in 1972, Federal agencies have only recently become concerned with or intimately involved in the development of the State coastal zone management programs. Washington was the first State program submitted and approved (June 1976) under the authority of the CZMA; thus, it was the first subjected to serious review by Federal agencies. The review and comments led to an extended delay in approval of the program and modification of the original submission as a result of some of the Federal reviewers' comments.[41] The problem of Federal agency involvement late in the program development process, coupled with lingering uncertainties concerning the scope of review and influence which these agencies have under the CZMA, will continue to recur. There is an indication that Federal agencies are not satisfied with simply reviewing the management *process;* they also want to shape if not determine the content of the programs by requiring, for example, that sites be designated for energy facilities.[42] This was evident in the Washington case: [43]

> ". . . with Maine, Washington and other states now beginning to submit their coastal management programs to the OCZM for review, this fledgling agency [OCZM] is in something of a dilemma. On the one hand, it does not want to overstep its statutory mandate by second-guessing states on matters such as energy planning. On the other hand, it is being pushed by the FEA (Federal Energy Administration) [now the Department of Energy] and other agencies to reject state

[39] Coastal Zone Management Act, op cit. note 31, Sec. 1456(a).

[40] Ibid., Section 1456(a).

[41] Marc Hershman and Robert Goodwin. Coastal Resources Program, University of Washington, Ports and Coastal Management, draft manuscript report. Seattle: University of Washington, 1977.

[42] Joseph M. Heikoff. *Coastal Resources Management: Institutions and Programs.* Ann Arbor: Ann Arbor Science, 1977, p. 15.

[43] Luther J. Carter. "Energy and the Coastal Zone: Pulling and Hauling Among the Feds," *Science* 188 (1975), p. 1288.

plans that do not specifically provide for energy facility siting. In instances where the omission is clearly arbitrary, the OCZM will be on safe legal ground in complying with the agencies' demand. Absent such arbitrariness, the OCZM either will have to stretch the letter of the law (as it understands the law) and require program revisions, or it will have to reject the energy agencies' demands."

In dealing with the issue, the State of Washington noted that the views of Federal agencies are varied and sometimes conflicting and, rather than adopt specific suggestions, maintained that the coastal program need only provide a process to accommodate the various views. The final environmental impact statement on the Washington program regarding the national interest in facility siting declared that the State was not obliged to plan for certain facilities, only that national concerns be included in State planning at an early stage and not arbitrarily excluded. In exchange, the State expected to be consulted on Federal agency projects or decisions taken in the national interest.[44] (A separate energy siting council exists in Washington.)

States adjacent to potential offshore oil and gas resources, or which are strategically located with regard to oil and gas imports, processing, and transshipment, are likely to come under close scrutiny by the Department of Energy and the Department of the Interior. To the extent that other States' programs may affect use of coastal areas of wide-scale national importance, they too will be subjected to critical review by resource management agencies.

The discussions between Federal mission agencies and State coastal programs (and NOAA) point up one of the problem areas of coastal management. While the national program envisioned a Federal role restricted to the process by which States and communities were going to guide future use of the coasts, it is difficult not to become involved in questions of substance.

The impact of the Federal consistency provisions on the programs of Federal agencies is yet to be determined. Until specific cases are before the administrative bodies and the courts, the precise meaning of the provisions in Section 307 are uncertain. Implementing regulations have taken more than 18 months to prepare. To what extent the Secretary of Commerce will intercede to override will also be determined on a case-by-case basis.

State Agencies and the Administration of Coastal Programs

There is little doubt that the expectations of the proponents of the Coastal Zone Management Act were for a strong agency and central authority in the State government to administer the coastal zone program. In 1972, the Coastal Zone Workshop prescribed a strong, independent State agency to administer coastal zone programs: [45]

> "The State coastal zone authority should be established as an independent agency, with its expertise and primary responsibility exercised in cooperation with other State agencies involved in the coastal zone. Management programs should view the coastal zone as a complete, natural system and not be restricted by political boundaries."

The Workshop's findings were a reaffirmation of the Stratton Commission's conclusions.[46]

Nevertheless, neither the actual CZMA nor the rules and regulations promulgated under the Act specify a detailed institutional structure for coastal management by the States. Federal requirements are concerned more that the agency have particular functions and powers than that it have a specific form.[47] While the governor of a State is required to designate "a single agency to receive and administer the grants for implementing the management program" under Section 306, there is no specific requirement that the agency must possess the sole regulatory authority for administering the substantive provisions of the coastal program in that State. The CZMA requires a description of the organizational structure proposed to implement the management program, including the responsibilities and interrelationships of local, areawide, State, regional, and interstate agencies in the management process.[48] Furthermore, the Act writes in a role for local government, recognizing even in 1972 the political difficulty inherent in the State override approach.

While the CZMA is explicit in its requirements for States to consult and coordinate with Federal, local and interstate agencies, it is vague about the relationships between the designated coastal management agency and the other resource management and regulatory agencies in the State. The tacit assumption, as suggested by the legislative history of the CZMA and subsequent statements of its sponsors, is that the designated coastal management agency would be a strong guiding force developing

[44] U.S. Department of Commerce, State of Washington Coastal Zone Management Program. Final Environmental Impact Statement. Washington, D.C., NOAA, Office of Coastal Zone Management, 1976, p. 100.

[45] Bostwick Ketchum. op. cit. note B, p. 31.

[46] Panel Reports, volume 1, op. cit. note 1, p. III–56.

[47] Joseph M. Heikoff, op. cit. note 42, p. 28.

[48] Coastal Zone Management Act, op. cit. note 31, Sec. 1454(a)(6).

policy and administering the State coastal zone management program.[49]

The character, efficiency, and strength of the State agencies that have been assigned responsibilities for developing or administering coastal management programs vary considerably among States (table 4–3). The "adoption" of a coastal management program by a State does not require that a State create a new coastal zone agency and endow it with operating authority through enabling legislation. A governor may designate an existing agency as the coastal zone agency and use existing single-purpose laws to implement the coastal zone management policies decided upon. This procedure has been termed "networking" and is the chosen course of a number of the States because it frequently requires no legislative action. No hard and fast conclusions can now be reached about the effectiveness of networking as a management approach, yet it does not fit the earlier notion of a single, strong agency administering a comprehensive coastal zone management statute.

Table 4–3.—Personnel and contracting activity of selected State coastal zone programs involving Federal funds [1]

[As of July 21, 1977]

State	Full-time personnel	Part-time personnel	Contract amounts budgeted FY 1977
California [a]			
California Coastal Commission	12	3	$249,097
Florida			
Department of Natural Resources [b]	19	—	482,870
Maine			
State Planning Office	11	1	382,436
Massachusetts			
Executive Office of Environmental Affairs	29	1	426,539
Michigan			
Department of Natural Resources	10	18	302,870
North Carolina			
Department of Natural & Economic Resources	26	2	232,325
New Jersey			
Department of Environmental Protection	29	4	266,900
New York			
Department of State, State Planning Division	27	2	1,055,973
Pennsylvania			
Department of Environmental Resources	4	14	232,125
Texas			
General Land Office	15	16	1,202,545
Washington [a,c]			
Department of Ecology	14	—	1,562,605

[1] Source: Office of Coastal Zone Management, NOAA.
[a] Additional personnel, not Federally funded, known to work on coastal zone management.
[b] To be changed to Department of Environmental Regulation.
[c] In administration stage.

The question about networking is whether it can provide the comprehensive approach to dealing with coastal lands and waters as a system, the original concept of the program. Can the piecing together of regulatory authorities which deal with specific aspects of the coasts form the basis for a program that was to treat the coasts as a complex, interrelated system? The answer to the question will be one of the main tasks of any evaluation of State programs.

Networking may involve simplifying the various State permit and licensing procedures. This generally entails pulling together various State-level permits, as administered by different agencies, into either a one-stop permit process or at least a more streamlined procedure for applicants; e.g., permits for wetland alteration, wildlife protection, beach dune protection, use of submerged land, and similar specific State-controlled activities.[50]

Local Government and Coastal Zone Management

The Coastal Zone Management Act was based on the perception that local and municipal governments are unable to manage the coastal resources in an effective manner. The key elements of the CZMA are: (1) that it should provide *unified* policies, standards, and processes for managing coastal resources that are applicable Statewide, and (2) that it would govern land and water uses of *more than local concern*. Thus, power over decisions of "more than local concern" would be taken at least in part from local control and re-established at the State level through a Statewide coastal management program; specifically contemplated is a system of State review of local decisions for acceptability.

The dichotomy of "local" and "more than local" has been bothersome since the inception of the coastal zone management effort. The only consolidated opposition to the concept of coastal zone management prior to the enactment of the CZMA came from the local and municipal governments that foresaw erosion of their control over their own development. Decisions of purely local concern would presumably be left to local governments. "Local concern" is intuitively defined as those decisions that have no effects beyond the boundaries of the local political jurisdiction.

The ambiguities in distinguishing local decisions

[49] Senator Earnest F. Hollings. Letter to the editor, *The Washington Post*, 19 March 1974.

[50] Interview with William Matuszeski, State Programs Office, Office of Coastal Zone Management, NOAA, Washington, D.C., 21 July 1977.

from non-local ones, and the basic resentment toward State involvement in local decisions, have perhaps worsened rather than improved since the adoption of the CZMA. The General Accounting Office (GAO), in reviewing the coastal zone management program, found State-local relationships troubled.[51]

> "In our opinion, resistance [to coastal planning efforts] exists because (1) local governments may regard coastal zone management as an example of Federal-State interference in planning decisions traditionally made by localities and (2) the public, especially coastal landowners, contend that State management programs infringe on their private property rights and affect property value by restricting the uses to which their land can be put. For instance, California has felt resistance even though the public established the State's coastal zone management by popular initiative in 1972. According to State and regional officials in Michigan, there is strong local opposition to expansion of State land-use powers. A State coastal zone management program official said there has been substantial local resistance to the somewhat limited State regulatory powers that currently exist."

In some States, the coastal zone program has brought about, at least on the staff level, better communication and improved relationships. In North Carolina, for instance, the State approach has been to pass through the funds for coastal cities and counties to develop the actual coastal plans. This has served to upgrade the professional plannning capabilities of the coastal governments. There has been a similar upgrading of capacity noted in Washington State under the program implementation (section 306) funding there. Where there is a good working relationship between local and State professional staff, accommodations between the two levels of government can be worked out informally. This appears to be taking place in some instances under the coastal management program.

The State-local relationship surfaced in the debate on the energy impact provisions of the Coastal Zone Management Act Amendments of 1976. Provision was made for local comment on any State land use or water use decision that conflicts with a local government ordinance.[52] The House Merchant Marine and Fisheries Committee report on the bill stated that the intent of the provision is to "protect the interests of local units of government."[53]

This little-noticed addition to Section 306 of the original Coastal Zone Management Act represents a shift in emphasis. From the original concept that State agencies would, by virtue of their broader perspectives and non-dependence on property tax revenues, be better able to reach balanced coastal zone decisions, there seems to be emerging a trend toward providing the local governments with a stronger role in coastal decision-making in the coastal management program. The 1976 amendment reflects this trend.

Consistency Provisions and State Expectations

The Coastal Zone Management Act is an exercise in persuasion. There are no compulsory reasons why States must participate. Three provisions of the CZMA as amended offer incentives to the coastal States to enter the program: (1) development and administrative grants under Sections 305 and 306, (2) Federal consistency requirements, under Section 307, and (3) participation in the 305 and 306 grant programs to assure receipt of coastal energy impact funds under Section 308. (States can qualify for such aid with their own coastal management programs.)

Although the requirement that Federal activities conform to State plans and objectives is an exception to the rule, it is not unique to the Coastal Zone Management Act. The Intergovernmental Cooperation Act of 1968, Title IV, requires that Federal aid for private development purposes be consistent with State, regional, and local comprehensive planning, "to the maximum extent possible." The prospect for a measure of control over Federal activities offshore and within the coastal region is, however, a powerful potential incentive for the States to participate in the CZMA. Whether the expectations of the States will be fulfilled will depend on the final operation of the consistency provisions through the cooperation of the Federal agencies and the definitions of the uncertain terms used in the Act by the court on a case-by-case basis. The provisions of Section 307 may turn out to be as pregnant with legal uncertainties, if not as prolific in causes of action, as the National Environmental Policy Act of 1969 (NEPA).

The General Accounting Office, in reviewing the provision, labeled Federal consistency as "an uncertain prospect." GAO concluded that,[54]

> "The problem is that, notwithstanding CZMA's Federal consistency provision,

[51] U.S. General Accounting Office, op. cit. note 29, p. 27.
[52] Coastal Zone Management Act Amendments of 1976. P.L. 94–370, Sec. 306(c)(2)(B).
[53] U.S. Congress, House of Representatives. Coastal Zone Management Act of 1976, Report No. 94–878, 94th Cong., 2d sess, Washington, D.C., Government Printing Office, 1976, p. 37.
[54] U.S. General Accounting Office, op. cit. note 29, p. 86.

> Federal agencies operate under a variety of laws for the most part passed independently of one another. Because [the Act] does not supersede or modify existing legislation or affect other congressional or executive mandates, Federal agency activities will not always be consistent with State management programs. For instance, the Corps of Engineers could not comply with State coastal zone management regulations that are contrary to or less restrictive than Corps policies and regulations based on other Federal legislation."

On the other hand, as pointed out by GAO, some States are counting on firm and straightforward administration of the consistency provisions. They are wary of the discretionary power of the Secretary of Commerce to overrule a State's finding of inconsistency on the basis of review of fact and substantial compliance or through the exception for purposes of national security. According to GAO,[55]

> "States could oppose such a determination by taking legal action through the courts. This would result in additional delays. States could express their opposition by withdrawing from the Coastal Zone Management Program."

Coastal Energy Impact Program

Over two-thirds of the Nation's remaining oil and natural gas supply is on the Outer Continental Shelf and in Alaska. As a result of the Arab oil embargo of 1973, accelerated development of these reserves has been proposed as a means to reduce U.S. dependence on imported oil and gas. Most of the potential offshore reserves are in previously unexplored areas of the Atlantic and Alaska Coasts (frontier areas).

Administration proposals in 1974 to lease 10 million acres in the OCS (equivalent to the total acreage leased since Federal leasing began in the OCS in 1953) met State opposition. Questions were also immediately raised about the practicality of the plan from the standpoint of industry capacity. This lead to a coastal governor's meeting in Washington, D.C., in the fall of 1974, which was addressed by President Ford in an effort to quell the opposition. The 10-million-acre target was modified in 1975.

The States were concerned with the prospect of drilling off their coast for two principal reasons. First, the federal OCS leasing program provided the States limited opportunity to participate in the leasing decisions of the Department of the Interior. Second, coastal States would have to accommodate the shoreside support facilities and provide services for the employees and families of industries associated with the offshore operations—while all of the royalty payments went to the Federal Government.

Sparring between the States and the Department of the Interior over the anticipated impacts of offshore oil and gas development led to proposals to compensate the affected States or otherwise ameliorate plan for means to accommodate the impacts from OCS development. The proposals, some of which included compensation for any impact associated with any energy facility, whether OCS-related or not, included grants, loans, and direct sharing of revenues from OCS leasing.

Energy planners were concerned that recalcitrant State or local governments could block or severely limit the expansion of OCS oil and gas production. State control of the continental shelf in the territorial sea seaward to 3 nautical miles (further in the Gulf of Mexico), and the State police power over onshore siting of facilities and pipeline corridors could frustrate Federal development of the OCS indirectly through the denial of permits or through zoning actions. Thus, the impetus for the Coastal Energy Impact Program was as much to reduce potential opposition to offshore drilling and production as it was to provide fiscal relief for possible adverse impacts.[56]

Two congressional studies, one released immediately before enactment of the CZMA amendments and the second completed at the time of enactment, reached essentially the same conclusions: Except for certain cases in the frontier areas, e.g., small, isolated areas such as Yakutat, Alaska, which is adjacent to attractive lease sale areas in the Gulf of Alaska, there will likely be little significant *permanent* disruption of the socio-economic structure of coastal regions as a consequence of offshore oil and gas development.[57] The problem to the extent that it existed, was found to be short term—a matter of revenue collection not matching early expenditures.

The debate concerning energy impact aid to the States centered not on whether such aid should be provided by the Federal Government, but in what form. The "developed" States, particularly Louisiana,

---

[55] Ibid., p. 77.

[56] See colloquium between Senators Harry Bellmon (R-Oklahoma) and Ted Stevens (R-Alaska) in U.S. Congress, Senate, *Congressional Record*, Washington, D.C., Government Printing Office, July 17, 1976, p. 12816.

[57] The first study, made by the Congressional Research Service of the Library of Congress, was released in March 1976, U.S. Congress, House Ad Hoc Select Committee on Outer Continental Shelf. *Effects of Offshore Oil and Natural Gas Development on the Coastal Zone*. 94th Cong., 2d sess., Washington, D.C., Government Printing Office, 1976; the second study, compiled by the Office of Technology Assessment, was released after action on the Coastal Zone Management Act Amendments of 1976 was completed. U.S. Congress, Office of Technology Assessment, *Coastal Effects of Offshore Energy Systems*. Washington, D.C., Government Printing Office, 1976.

together with others opposed to additional Federal bureaucracy, argued forcefully for a revenue sharing or an automatic formula approach. The Ford Administration opted for a combination of loans and bond guarantees. In final form, the CZMA amendments creating the Coastal Energy Impact Program include grants, loans, bond guarantees, and formula grants.

The major restriction on the availability of the "formula grants" for public facilities and services is that such money can only be used because of the "unavailability of adequate financing under any other subsection" of the impact assistance program. That means that as long as loans and bond guarantees are available, grants to the States will be generally restricted to planning assistance, and compensation for environmental and recreational losses. Proponents of the automatic or formula grant approach had wanted funds under this provision to be available for public works projects. It was on this point that the Ford Administration balked.

The Administration made the difference between reliance on grants or loans a major question of principle. The loan approach was seen by its supporters in OMB and the Commerce Department as a precedent for any inland impact assistance programs which might be contemplated and, in fact, as a broader precedent for adjustment assistance in general. The advocates of the loan-bond guarantee approach hoped the success with the coastal impact program would lead to the consolidation of other assistance programs; specifically mentioned in this discussion were aid programs run by the Department of Agriculture, Economic Development Administration (Commerce), Department of Defense, Department of Health, Education, and Welfare, and Department of Housing and Urban Development.

At present, however, the carefully worked out construction of the energy impact program is being revised. In dealing with legislation altering the Outer Continental Shelf Lands Act, the Congress is currently discussing removing some of the restrictions on application of the "formula grant" section as well as increasing the money available through this vehicle.[58] Alterations were made by the program administrators in revised regulations issued early in 1978.

Implementation of the loan provision has been delayed by a lack of agreement on the interest rate to be applied. The Office of Management and Budget recommends the official Treasury rate. The program managers contend this will effectively make the loan program useless since States and localities can by and large obtain better rates on their own without difficulty.

Proponents of the automatic grant type of assistance for coastal States base their case in part on the fact that western States with minerals on Federally owned lands receive 50 percent of the royalty income, to help compensate for the needed new governmental services required since no State revenue accrues for the activities on the Federal property.

A second major question is whether either grants or loans for facilities and services are appropriate. That is, are the changes in communities brought about by the introduction of a heavy industry such as the offshore oil industry susceptible to being treated with Federal aid?

There is evidence, as in studies of western mining towns, that the most severe impacts from large-scale energy development may be psychological. Researchers have come to label this the "Gillette Syndrome," named for the town of that name, said to consist of drunkeness, depression, delinquency, and divorce. Researchers have found that planning assistance to help communities prepare for change is often of limited help because many rural communities are hostile to planners and planning.

The solution for some coastal States faced with the offshore industry for the first time has been to attempt to funnel any prospective support industry into existing urbanized areas. For instance, Massachusetts has proposed five coastal cities, some with chronic unemployment, as potential supply bases and has actively courted the off shore industry. A study by Princeton University's Center for Environmental Studies, released August 22, 1977, proposes that New Jersey locate any support industry for offshore development in Atlantic City. It further suggested that certain facilities, such as tank storage farms, be located inland from the coast, near major highways. The study also noted that the State needed to assume leadership, because local communities might, if left to make siting decisions themselves, allow environmentally damaging locations for immediate tax revenue benefits.[59]

An argument put forth in justification of Federal aid to coastal States adjacent to offshore oil and gas operations is that the proceeds from such activity go entirely to the Federal Government, while expenses for services and facilities generally are borne by the local and State governments. The difficult factor to calculate is how much local and State revenue is generated by the onshore facilities or by the oil/gas production itself in States that tax same, and whether this revenue will keep up with expenditures. The evidence points to a short-term shortfall. There is also the question of whether a State's tax load is "fair;" in other words, does it do enough to raise revenues itself?

[58] H.R. 1614, Outer Continental Shelf Lands Act Amendments of 1977, Title IV.

[59] *New York Times*, August 23, 1977.

The most thorough study done on this question, dealing with Delaware and New Jersey, declares that after an initial shortfall, the long-run effect on States and communities is positive in terms of revenues as offset by expenses. A major exception is where one community or State gets the revenue, while an adjoining area has the expenses; in such a case the long-term as well as short-term effect would be negative.

In its study, *Coastal Effects of Offshore Energy Systems,* dealing with impacts that might be expected in coastal Delaware and New Jersey, the Office of Technology Assessment (OTA) concluded: [60]

> "OTA has prepared a fiscal analysis of costs and revenues from (Outer Continental Shelf) activities in the States of New Jersey and Delaware assuming projected development associated with discovery of 1.8 billion barrels of oil in the Baltimore Canyon Trough. The fiscal analysis concludes that, in general, per capita tax revenues from OCS-related activities would be considerably higher from the fourth year onward than statewide per capita revenues from other sectors under the assumptions of the study . . . If, however, most of the support areas and OCS employees were located in one State and the landings of oil and natural gas were made in another, the results would be very different . . .
> "In 1972, per capita state and local revenues in New Jersey were $847. Before any major onshore investments occurred, revenues produced by OCS activities would be primarily from individuals which average $512 per capita in New Jersey. Assuming that per capita expenditures for public services are about equal to total per capita revenues of $847, per capita expenditures to support OCS-related population would exceed the per capita revenues from OCS activities by about $335 during the first two years of development. The gap would decrease to $225 in the third year as some business taxes accrued. The picture would change in the fourth year when major onshore investments would be made for pipelines, tank farms, and natural gas processing plants. In the year when these investments would be made, the State would receive revenues from a real estate transfer tax and from its sales tax (or equivalent use tax). Since these are assumed to be concentrated in the fourth year, the per capita tax revenue is calculated to jump nearly $11,000 in that year in New Jersey. The jump would not be so pronounced in Delaware where there is presently no sales tax. In subsequent years, the property tax would be the main source of revenue. Property tax revenues would decline on a per capita basis for a period because they would be divided among an increasing direct population engaged in offshore construction and development drilling. Finally, per capita property tax revenues would begin to rise in the ninth year when completion of construction would lead to a decrease in OCS-related population. For all years after the fourth year, per capita revenues from OCS activities would substantially exceed the statewide average."

The OTA study supports the position of those who advocate loans and bond guarantees to provide needed facilities and services early, and use of revenues to pay them off in time. The study suggests that loans need only be short-term because, as offshore fields are developed, revenues will very soon come to exceed expenditures by sizable margins. This is so because the support facilities needed for the offshore industry are heavily capitalized and produce high revenues with relatively few workers after they are installed and operating.

A recent study on OCS issues published by the Council on Environmental Quality contains evidence that community support for the introduction of the offshore industry is fairly considerable.

In Kenai, Alaska, for instance, an isolated rural community of about 1,000 has been transformed by production of oil and gas resources in State-controlled waters in nearby Cook Inlet. The community went through a rapid expansion and then decline after initial construction of facilities was completed. New community services were required, as was additional housing. The evidence is that the area absorbed the four-fold increase in population and the disruption of its previous way of life successfully.[61]

A survey of residents and city officials gave the following assessment of the change brought to Kenai:[62]

> "Many respondents mentioned a better standard of living, more diverse jobs, increased land values, and better roads,

[60] U.S. Congress, Office of Technology Assessment. *Coastal Effects of Offshore Energy Systems.* Washington, D.C., Government Printing Office, November 1976, p. 157.

[61] Council on Environmental Quality. *Oil and Gas in Coastal Lands and Waters.* Washington, D.C., Government Printing Office, 1977, p. 65.

[62] Ibid.

medical care and schools. They also noted that there was less friendliness, less privacy, and—for the first time—discrimination."

In rural Virginia there have been hot debates for 2 years on the issue of whether the community of Cape Charles and Northampton County want to be the site of a 2,000-employee plant to construct offshore oil platforms. The issue was put before the voters in a county commission election. One group opposed the project, the other favored it (with certain limits, such as the number of workers). The result, in November 1975, was a turnout of 83 percent of the eligible voters, who handily approved candidates favoring the project.[63]

> "The vote was not a referendum, and no doubt other issues affected the outcome. But, the message was clear that citizens did not wish to reject the Brown and Root proposal. What is most likely is that many Northampton County citizens believed that large-scale industry and economic revival are not necessarily at odds with the peace, beauty, enjoyment of neighbors, and closeness with nature that they love about the shore."

Status of the Coastal Zone Management Program

State coastal zone management programs are in two basic stages—the planning effort or program development stage (authorized by Section 305 of the Act) and the operational or program administration stage (specified in Section 306 of the Act). A third phase consists of miscellaneous features. Chief among the latter is the $1.2 billion 10-year coastal energy impact program enacted in 1976, which is loosely tied to coastal management programs.

This section describes program development since approval of the Act, efforts to evaluate the program underway in 1978, the status of each State's program, and, in greater detail, the coastal zone management program for the State of Washington—the first State program to be approved.

Program Development

The pace of program development since approval of the Act in 1972 has been slower than expected—not unlike other environmentally oriented programs. From the Stratton Commission's recommendation of Federal assistance for an initial 2-year period, the program was expanded to a 3-year planning effort authorized by the original 1972 act. The 1976 amendments provide a fourth year of funding under Section 305 in recognition of the difficulty States are having in developing viable coastal programs, plus an additional 2-year period allowed under Section 305(d) for a "preliminary approval" status. States will continue to receive funds under this extended 2-year period if their program design is satisfactory, in the event that additional time is needed for administrative reorganization or legislative enactment. Funding for section 305 development grants is scheduled to expire in fiscal year 1979.

The projected goals for coastal zone management programs by the State reveals a record of missed target dates and a propensity of the Office of Coastal Zone Management (OCZM) to be overly optimistic in its estimates of State program schedules.

In February 1976, OCZM predicted 17 States and two segments of State coasts would be eligible to receive program operation money (Section 306 funds) by the end of fiscal year 1977. Actually, only two West Coast States (Washington and Oregon), plus segments of California (San Francisco Bay) and Puerto Rico (Culebra Island) were approved by that date. In testimony before the House Appropriations Subcommittee with jurisdiction over the Department of Commerce budget, it was projected that the remaining 19 States would have their programs completed by the end of fiscal year 1978.

The projected completion dates of State coastal management programs have been consistently wide of the mark (table 4-4). A projection made on August 1, 1977, notes that in 5 of the 16 States expected to complete their program in fiscal year 1978, success depends on legislative action. The OCZM document says a "pessimistic" view has four instead of eight programs being finished in the first half of 1978 (table 4-5).

To some observers the time scale for coastal zone management has been unrealistic from the start, beginning with the initial 3-year period enacted by the Congress. In this view, the process should have been thought of as a 10-year effort from the outset, in recognition of the inherent difficulties involved.

The Federal expenditures for the program through September 30, 1977 include $64.5 million of funds distributed to the States under the three original

---

63 Ibid., p. 107.

Table 4–4.—Coastal zone program approval schedule [1]

[Number of State programs]

Date of estimate	FY 1975 Est.[2]	FY 1975 Act.[2]	FY 1976 Est.	FY 1976 Act.	FY 1977 Est.	FY 1977 Act.	FY 1978 Est.	FY 1979 Est.
April 4, 1974	4+1[a]	0						
April 14, 1975	4+1	0	5[b]	1[g]	23	2+2[h]		
February 9, 1976			3+1[c]	1	14+1[d]	2+2	19	
March 8, 1977					6	2+2	16[e]	17
August 1, 1977					3+2	2+2	19[f]	?

[1] U.S. House of Representatives, Hearings, Departments of State, Justice, Commerce, Judiciary and Related Agencies Appropriations for Fiscal Year 1975, 1976, 1977, and 1978, p. 800 (part 3), 287, 903, and 501 (part 4), respectively.

[2] Estimated for approval and actually approved.

[a] Four States and one coastal segment.

[b] New Hampshire, Michigan, North Carolina, Oregon, Rhode Island.

[c] California segment, Oregon, Washington, Rhode Island.

[d] Cumulative California, Delaware, Maine, Maryland, Minnesota, New Hampshire, New Jersey, North Carolina, Oregon, Puerto Rico segment, Rhode Island, South Carolina, Texas, Virgin Islands, Washington.

[e] Cumulative: California, Delaware, Illinois, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, North Carolina, Oregon, Puerto Rico, Rhode Island, Texas, Virgin Islands, Washington, Wisconsin.

[f] Cumulative: Washington, Oregon, California, Virgin Islands, Illinois, Maine, Maryland, Massachusetts, North Carolina, Rhode Island, Wisconsin, Delaware, Florida, Guam, Minnesota, Michigan, New Hampshire, New Jersey, Puerto Rico.

[g] Washington.

[h] Washington, Oregon, California segment, Puerto Rico segment.

Table 4–5.—Status of Coastal Zone Management Act Section 306 approvals

[Prepared by Office of Coastal Zone Management, NOAA—August 1, 1977]

State	Draft of EIS status[1]	Expected Section 306 approval date	Budgeted 1978 by OCZM Section 306
First half of 1978[2]			
Oregon		May 1977	$ 1,400,000
Washington		1977 is second year of Section 306 program	1,400,000
California		September 1977	3,000,000
Virgin Islands		October 1977	500,000
Illinois	Depends on State legislation	June 1978	1,100,000
Maine	Issue November 1977	March 1978	1,000,000
Maryland	Issue November 1977	April 1978	1,150,000
Massachusetts	Issue September 1977	February 1978	1,100,000
Michigan	Issue October 1977	March 1978	1,250,000
North Carolina	Issue November 1977	March 1978	1,150,000
Rhode Island	Issue October 1977	March 1978	800,000
Wisconsin	Issue October 1977	February 1978	1,100,000
TOTAL:			14,950,000
Second half of 1978[3]			
Delaware	Depends on State legislation	June 1978	787,000
Florida	Depends on State legislation	September 1978	—
Guam	Depends on State legislation	September 1978	—
Minnesota	Issue January 1978	August 1978	—
New Hampshire	Depends on State legislation	September 1978	400,000
New Jersey	Issue March 1978	September 1978	1,225,000
Puerto Rico	Issue March 1978	August 1978	950,000
TOTAL:			3,362,000

[1] EIS, Environmental Impact Statement.

[2] Possible approvals in first half of 1978: 8 States. Pessimistic estimate of approvals in first half of 1978: four States.

[3] States listed in first half that "slip" probably would be funded during second half of 1978. Some States listed in second half of 1978 may "slip" to 1979. These States, owing to shortage of Section 306 funds, would be funded effective October 1, 1978 (fiscal year 1979).

Table 4–6. Federal coastal zone funding March 1974 through September 1977

State	Program development Section 305	Program administration Section 306	Estuarine sanctuary Section 315
	dollars	*dollars*	*dollars*
Alabama	408,378		
Alaska	3,270,000		
California	3,848,668	120,979[a]	
Connecticut	1,120,832		
Delaware	989,746		
Florida	2,335,446		1,500,000
Georgia	1,095,365		1,550,000
Guam	542,045		
Hawaii	1,450,000		199,600
Illinois	1,140,000		
Indiana	562,280		
Louisiana	2,744,000		
Maine	1,872,650		
Maryland	2,450,386		
Massachusetts	2,270,430.58		
Michigan	1,915,325		
Minnesota	812,500		
Mississippi	513,638		
New Hampshire	642,000		
New Jersey	1,773,087		
New York	2,802,625		
North Carolina	2,349,067		
Ohio	1,219,000		894,152
Oregon	1,695,978	1,850,000	1,804,813
Pennsylvania	667,000		
Puerto Rico	1,358,843	292,626[b]	
Rhode Island	1,632,034		
South Carolina	1,337,463.82		
Texas	3,335,996		
Virgin Islands	390,000		
Virginia	1,408,764		
Washington	1,262,820	3,750,000	
Wisconsin	1,304,150		
Total:	52,520,577.40	6,013,605	5,948,565
Federal grant funds			$64,482,741.40
State matching funds (approximately)			$25.4 million
Administration (Federal)			$ 7.7 million
Grand total			$97.5 million

[a] Segment of State: San Francisco Bay.
[b] Segment of Commonwealth: Culebra Island.

titles of the Coastal Zone Management Act plus $7.7 million [64] for the cost of administering the program through the Office of Coastal Zone Management, a total Federal expenditure of $72.2 million.

In addition to the Federal grants awarded to the States for program development, administration and estuarine sanctuaries (Sec. 315(1)), State matching funds amounting to one-third for development grants and administrative grants, and one-half for the estuarine sanctuaries program, raised total public expenditures through fiscal year 1977 (excluding the coastal energy development program) on coastal zone management to about $100 million (table 4-6).

The program delays which have characterized the State coastal zone management initiatives may have been caused by either administrative shortcomings or inherent deficiencies in the concept of the program itself. Several studies of coastal zone management will be undertaken in 1978. The Department

[64] NOAA Office of Coastal Zone Management figures for fiscal years: 1973 (reprogramed funds), $250,000; 1974, $555,000; 1975, $1,178,000; 1976, $1,739,000; transition quarter, $523,000; 1977, $3,239,000; 1978 (estimate), $3,155,000. Total through fiscal year 1977, $7,734,000; estimated total through fiscal year 1978: $10,889,000.

of Commerce has announced that it will undertake a full-scale assessment of the program in addition to an internal review by NOAA. Both the Senate Committee on Commerce, Science, and Transportation and the House Merchant Marine and Fisheries Committee have announced plans to hold oversight hearings on the coastal zone management program in the near future. Both the Coastal Zone Management Advisory Committee and National Advisory Committee on Oceans and Atmosphere may undertake examinations also.

Because the program is at a relatively early stage, with only three State programs operating, it is premature to conclude how effective it will be. The evaluation efforts underway in 1978 will be important in that they will be the first thorough examination made with enough State programs available to allow a preliminary judgment.

Description of State Coastal Zone Management Programs

The status of each State's Coastal Zone Management Program in early 1978 is described, including the legal authorities proposed by the State to administer its coastal program. The descriptions are based on information provided by NOAA's Office of Coastal Zone Management. Expenditures noted are Federal funds allocated to the States as authorized by the Coastal Zone Management Act of 1972 from March 1974 through September 1977—for program development (preparation) under Section 305, for program administration (management) under Section 306, and for estuarine sanctuaries under Section 315. Funds dispensed under the Coastal Energy Impact Program (Section 308) are not included.

Alabama

Federal Funding

Program Preparation (Section 305)

1974:	$100,000
1975:	151,418
1976:	
1977:	156,960
Total:	408,378

Current Status

The Alabama Coastal Area Board was established in 1974. In 1976, the legislature reconstituted the Board to include four local government officials from the coastal area, four State agency heads, and the chairman of the Citizen's Advisory Committee. The restructuring of the Boards' membership and authority caused delays in the hiring of staff and the development of program management activities. The Board is currently identifying the uses and areas that will be managed, and the procedures that will be used to assure consistency with the policies in the program.

Authorities

The Board is responsible for developing a comprehensive coastal area management program and for assuring that actions by agencies in the coastal area are consistent with the management program. No additional permits will be required from the Board if an existing State agency permit is required for an activity; current State permit activities will be subject to a determination by the Board that the permit will be in compliance with the management program. The coastal act allows significant local government autonomy.

Alaska

Federal Funding

Program Preparation (Section 305)

1974:	$ 600,000
1975:	1,200,000
1976:	1,470,000
1977:	
Total:	3,270,000

Current Status

The original thrust of the coastal zone management effort in Alaska was technical data collection and information dissemination. Much of this work has been accomplished through the technical services of State agencies. During the second and third years of program development, Alaska focused on policy development; State, local and Federal authorities that impact coastal resources; identification of boundaries and areas of particular state concern; and joint participation between the administrative and legislative bodies of government to develop acceptable coastal legislation.

With third year supplemental funding, Alaska started implementing certain parts of its coastal act, which requires the development of guidelines and standards for establishing a Policy Council. Local government involvement and development of District Programs is also required and is a major activity during the fourth year. Active citizen participation has been an integral part of the program during the third and fourth years, including Statewide public workshops on coastal issues and public hearings on the guidelines and standards.

Authorities

The Alaska Coastal Act of 1977 will form the foundation of the program. This establishes the process for developing a program as well as the institutional arangements to administer it. Additional State authorities will be used as necessary to enforce

the policies of the program. The State is currently considering passage of additional legislation such as Forestry Practices which may supplement the authorities of the management program.

California

Federal Funding

Program Preparation (Section 305)

1974:	$ 720,000
1975:	900,000
1976:	1,200,000
1977:	1,028,668
Total:	3,848,668

Program Management (Section 306)

1977:	$120,979
Total:	120,979

Current Status

For the first 3 years, California developed the Coastal Plan in response to a citizen's initiative (Proposition 20) that required a comprehensive plan for coastal resource preservation and use. Concurrently, the State was also directly controlling land and water uses through coastal development permit requirements. The Coastal Plan was introduced to the legislature, and, after considerable debate, the California Coastal Act of 1976 was approved.

Part of third year and fourth year work programs were devoted to implementing parts of the Coastal Act including the development of local coastal programs and approval of the management program under the Coastal Zone Management Act.

The State's management program was approved by the U.S. Secretary of Commerce, Juanita M. Kreps, in November 1977. The approval of the program has been contested in Federal Court by the American Petroleum Institute, et al.; the presiding judge allowed the program to be approved, but withheld the application of the Section 307 Federal consistency provisions of the Act until there is a hearing on the merits of the case.

California's first year implementation funds are devoted largely to processing thousands of coastal development permits and assisting local governments in developing comprehensive local coastal programs which incorporate the State policies established in the Coastal Act.

Authorities

The State's coastal management program is based on the California Coastal Act, the Coastal Conservancy Act of 1976, the Urban and Coastal Park Bond Act of 1976, and appropriate regulations developed pursuant to the Coastal Act. The State is currently in the process of refining its program to include the Liquefied Natural Gas Terminal Act of 1977.

Connecticut

Federal Funding

Program Preparation (Section 305)

1974:	$ 194,285
1975:	482,484
1976:	444,063
1977:	
Total:	1,120,832

Current Status

Connecticut began its third year of 305 program development during fiscal year 1977. Draft legislation was prepared for submission in January 1978. A recommended two-tier boundary is proposed, the first being about 1,000 feet from mean high water, the second being the first inland community.

Authorities

The State will need new legislative authority in order to meet the requirements of the Coastal Zone Management Act. A bill has been drafted and submitted to the State legislature. The legislation would place the coastal management agency in the Department of Environmental Protection. The management technique recommended is a shared State/local partnership with the local agencies assuming most of the responsibility.

Delaware

Federal Funding

Program Preparation (Section 305)

1974:	$166,666
1975:	345,000
1976:	
1977:	478,080
Total:	989,746

Current Status

Much of Delaware's first year of management program development was devoted to identifying and filling management data voids and in delineating areas of critical concerns, permissible uses, and priorities of uses.

Efforts during the second year of work included: (1) completion of much of the basic coastal resources and processes research work; (2) application of the general coastal management methodology to the needs and issues affecting the Lewes-Rehoboth portion of the coast; (3) intial determination of geographic areas of particular concern, including identification of unique and rare natural areas worthy of preservation; (4) initial listing of permissible uses; and (5) additional basic examination of existing legal and organizational arrangements.

During the third year, much of the work centered on producing a draft management program by February 1978, and on a legislative package to be

submitted to the legislature for consideration during its 1978 session.

Authorities

Delaware has three major statutes dealing with coastal resources: (1) The Coastal Zone Act, (2) Wetlands Act, and (3) the Beach Preservation Act. As it is necessary for the State to seek additional legislative authority, the following bills have been submitted to the legislature: (1) a bill which establishes a process for State involvement in local decisions that may be of more than local concern, (2) a critical areas bill, and (3) an erosion and sedimentation bill. If this legislative package is enacted, the State may have sufficient comprehensive authority to meet Federal requirements for a coastal zone management program.

Florida

Federal Funding

Program Preparation (Section 305)

1974:	$ 450,000
1975:	763,000
1976:	1,122,496
1977:	
Total:	2,335,496

Estuarine Sanctuary (Section 315)

1977:	$1,500,000
Total:	1,500,000

Current Status

The development of a coastal management program in Florida has been the responsibility of a succession of State agencies that have been supported by Regional Planning Councils and citizen advisory committees. The program development process has produced extensive planning and management information at the State and regional level and has made management recommendations in a number of areas, including boundaries, uses to be managed, and areas of particular concern. In 1977, the Florida legislature transferred the responsibility for completing the coastal management program to the Department of Environmental Regulation. The Department, assisted by a State Coastal Zone Management Committee, published a "Preliminary Workshop Draft Program" in November 1977. The document was reviewed by Federal agencies and discussed at a number of well-attended public workshops throughout the State in December. Following necessary revisions, the program and implementing legislation will be submitted to the governor and hence to the legislature in early 1978.

Authorities

There will be an attempt to pass legislation in 1978 that will ensure that existing State authorities and programs will be conducted in a manner consistent with the proposed policies of the coastal management program. Existing State authorities include, but are not limited to, permits relating to wetlands, beaches, as well as air and water quality, the Areas of Critical State Concern Program, the Development Regional Impact review process, and several special area programs such as the Aquatic Preserves Program.

Georgia

Federal Funding

Program Preparation (Section 305)

1974:	$ 188,000
1975:	416,250
1976:	
1977:	491,115
Total:	1,095,365

Estuarine Sanctuary (Section 315)

1975:	$1,500,000
1976:	
1977:	50,000
Total:	1,550,000

Current Status

The momentum of the development of Georgia's coastal management plan was interrupted during a reorganization within the Department of Planning and Budget and the program's subsequent relocation in the State Department of Natural Resources. In June of 1978, the State will enter its fourth year of program development.

Georgia has determined to seek coastal legislation, and during the third year the State developed legislative recommendations for the governor's review. The State has made substantial progress in determining procedures for citing uses of regional benefit and has begun addressing the national interest and energy facility siting requirements.

The State's inland boundary has been defined. The boundary extends 150 feet west of the Seaboard Coastline Railroad and Interstate 95. A nomination process has been recommended for future "geographical areas of particular concern" designation and selected natural, cultural, and recreational resource areas already have been designated.

Authorities

The State has prepared several pieces of legislation for introduction in 1978. This package consists of four parts: (1) a Coastal Siting Act, (2) Coastal Management Act of 1978, (3) Shore Protection Act of 1978, and (4) a proposed Constitutional amendment. The governor has determined to introduce the latter three bills during the 1978 legislative session. The Coastal Siting Act has been introduced for

study during the 1978 session and possible passage in 1979.

Guam

Federal Funding

Program Preparation (Section 305)

1974:	
1975:	$143,000
1976:	189,000
1977:	210,045
Total:	542,045

Current Status

In about 2½ years Guam has inventoried all of its major resources (including reefs and beaches), mapped and classified them, and has used this knowledge to provide the basis for a comprehensive land and water use program. A land-use element designed to take into account significant resources and user needs was published and distributed for review. A major effort has gone into drafting coastal legislation.

Authorities

In addition to Guam's Seashore Protection Act and territorial statutes, island-wide land-use legislation has been prepared for adoption by the legislature. This legislation consists of districting of land (patterned after Hawaii), the designation of permissible uses in those districts, and a process to designate areas of particular concern.

Hawaii

Federal Funding

Program Preparation (Section 305)

1974:	$ 250,000
1975:	400,000
1976:	500,000
1977:	300,000
Total:	1,450,000

Estuarine Sanctuary (Section 315)

1976:	$199,600
1977:	
Total:	199,600

Current Status

Throughout the development of its coastal management program, Hawaii has followed a classical planning approach. It has identified its coastal resources and the concurrent management problems, and has conducted a widespread public involvement program that was instrumental in problem identification and the passage of coastal legislation. Differences between the State and county governments as to the proper division of implementation responsibilities have been a continuing problem.

During its fourth year of program development, the State has been working on a management program that describes how the State will enforce the program's objectives and policies, both during an interim period of time during which local governments are to refine the coastal development permit boundary and be in compliance with State policies, and thereafter.

Authorities

The State will use both direct controls (particularly in coastal waters) and local implementation of State-established criteria and standards to control land and water uses. The Hawaii Coastal Zone Management Act of 1977 establishes State policies, requires local and State government compliance, requires developers to acquire a coastal development permit, and directs that the Hawaii program use other existing State authorities.

Illinois

Federal Funding

Program Preparation (Section 305)

1974:	$ 206,000
1975:	434,000
1976:	500,000
1977:	
Total:	1,140,000

Current Status

Illinois' Coastal Zone Management Program is in its third year of development within the Illinois Department of Transportation's Division of Water Resources.

The inland boundary follows property lot lines or transportation right-of-way lines and in either case is not more than 500 feet from Lake Michigan. The State's major coastal management policies are to minimize shore erosion, flooding, and property damage; protect water quality; protect offshore reef formation, coastal fisheries, and natural areas; promote shoreline recreation services and promote lake-dependent commercial, industrial, navigation, port, and energy facilities. The Illinois Coastal Zone Management Program has four areas of particular concern requiring special management attention: (1) the Illinois Beach State Park, (2) the Waukegan Harbor and lakefront industrial complex (3) the 100-year high-risk erosion area of Lake Bluff, and (4) offshore dolomite reef formations.

Authorities

The Illinois Coastal Resources Management Act (HB 2118) has been passed by the House of the Illinois General Assembly and will be voted on by the Senate in the next session. This Act establishes a permit system to be administered by either the State

or a "certified" municipality or county to control specified land and water uses. The governor would designate the Illinois Department of Transportation as the State implementation agency under Section 306 of the national act, and issue an executive order requiring State agency actions to be consistent with the coastal programs to the maximum extent practicable. The department would be responsible for certifying and decertifying local governments and for carrying out the State and Federal consistency elements of the State program. If HB 2118 is passed, Illinois will submit its program for Federal approval in July 1978.

Indiana

Federal Funding

Program Preparation (Section 305)

1974:	
1975:	$220,000
1976:	
1977:	342,280
Total:	562,280

Current Status

The Indiana State Planning Services Agency is responsible for administering the State's program development under Section 305 grants. The problems and issues identified during the first year of program development are grouped into nine areas: shoreline erosion and property damage, recreational resources, ecological and environmental concerns, economic development, commercial ports, aesthetics, jurisdictional responsibilities, land-use compatibility, and inadequate transportation. The Indiana Department of Natural Resources and two Planning and Development Commissions covering the coastal area collected data relating to the major natural, economic, and social characteristics of Indiana's Lake Michigan shoreland area during the first year. The planning agency organized a Technical Advisory Committee and a Citizens Advisory Committee.

Indiana's second-year application was delayed because of inadequate progress during the first year. Once the first-year products were completed satisfactorily, the Office of Coastal Zone Management made a second 305 grant to Indiana in September 1977.

Authorities

Some State legislation probably will be attempted in Indiana, but the principal controls probably will be maintained at the local government level.

Louisiana

Federal Funding

Program Preparation (Section 305)

1974:	$ 260,000
1975:	$ 485,000
1976:	999,000
1977:	1,000,000
Total:	2,744,000

Current Status

Louisiana began its fourth year of program development on June 30, 1977. The Governor, in August 1977, transferred responsibility for completing the coastal management program to the Louisiana Department of Transportation and Development, which had previously been designated as the State agency responsible for administration of the Coastal Energy Impact Program. Recent program development work has centered on assisting parishes (counties) in preparing local management programs, identifying categories of uses subject to management and special management areas, refining the boundary, and implementing the Coastal Energy Impact Program.

Authorities

In 1977, the Louisiana legislature enacted the State and Local Coastal Resources Act of 1977 (Act 705), prepared by the Louisiana Coastal Commission. This statute required each State agency and local parish to prepare management plans for the area within a 3-mile coastal boundary. The Office of Coastal Zone Management informed the governor that the bill was unsatisfactory in several areas and could not provide a basis for approval of a State program under the Federal act. The Department of Transportation and Development is drafting a new bill which will provide the authority for a State management program and permit system as well as procedures for approving local parish management programs that are consistent with State coastal policies and guidelines.

Maine

Federal Funding

Program Preparation (Section 305)

1974:	$ 230,000
1975:	474,870
1976:	457,970
1977:	709,810
Total:	1,872,650

Current Status

In 1976, Maine submitted and subsequently withdrew a proposed management program for its midcoast area, extending from Casco Bay to Frenchman Bay. The proposal was recalled in order to bring about a greater level of participation by town governments. Maine completed a draft of its coastal zone management program and held five major public hearings concerning it in November 1977.

Authorities

About two-thirds of the Section 306 grant fund will be available to help local communities implement the program. The proposed State coastal management agency is the State Planning Office. The Coastal Conservation Development Commission appointed by the Governor has provided overall guidance in program development. No new legislation will be sought in Maine. Instead, reliance on the 11 present State laws felt pertinent to the coastal area will be used in what is termed "networking" of existing authorities. Included are wetlands, critical areas, and shoreline zoning acts.

Maryland

Federal Funding

Program Preparation (Section 305)	
1974:	$ 280,000
1975:	560,000
1976:	810,290
1977:	800,096
Total:	2,450,386

Current Status

Maryland's initial efforts in coastal management planning were research-intensive, with certain specific targets set during its second year of program development. The State has focused on completing the resource inventory necessary to determine geographic areas of particular concern; initiated a study of onshore development associated with OCS activities; established a public participation framework within which program elements may be reviewed and appropriately modified; completed a draft comprehensive dredge spoil disposal plan; completed inventory and analysis of institution and authorities for managing coastal areas to determine the remedial action necessary; and worked with relevant State and Federal agencies and local governments in an effort to ensure consistency as permissible uses of the coast are identified.

Following governmental reorganization that placed primary responsibility for coastal planning under the Energy and Coastal Zone Administration, a clearer course of action toward coastal program approval is emerging. Major objectives of the State's third year of coastal planning are: (1) a greater effort toward soliciting public and local government participation; (2) work on the Baltimore Metropolitan Coastal Area Study; (3) initiating a coastal use capability study to develop a management mechanism for using resource information; (4) work with the Department of State Planning to recommend mechanisms to meet the requirements for authorities and organizational networking; (5) additional emphasis on State-Federal coordination; and (6) preparation of the management program document.

Authorities

The Maryland program document has been completed and is under review by the Office of Coastal Zone Management. An executive order, signed by the governor, is needed to create a network of already existing State authorities and provide a conflict resolution mechanism necessary for Federal program approval. The program uses five present State authorities on: wetlands, coastal facilities review, powerplant siting, shore erosion, and flood control watershed management laws.

Massachusetts

Federal Funding

Program Preparation (Section 305)	
1974:	$ 210,000
1975:	492,330.58
1976:	917,100
1977:	651,000
Total:	2,270,430.58

Current Status

The Massachusetts Coastal Zone Program has received preliminary approval under Section 305(d). A preliminary program was submitted for public review in December 1976 and to the Federal Office of Coastal Zone Management in summer 1977. The draft environmental impact statement was circulated in fall 1977. Federal approval of the program was scheduled for early 1978.

Authorities

Massachusetts has based its program on existing authorities. The State passed strong environmental laws in the 1960s and early 1970s and is using the coastal program to implement them more effectively. Among the State laws to be used are two coastal wetlands acts, the offshore minerals act, an ocean sanctuaries act, and the State environmental policy act.

Michigan

Federal Funding

Program Preparation (Section 305)	
1974:	$ 330,486
1975:	400,000
1976:	529,839
1977:	655,000
Total:	1,915,325

Current Status

The Michigan coastal zone boundary has been designated as including all lakeward coastal areas within Michigan's jurisdiction and landward coastal areas extending to a minimum of 1,000 feet inland of the ordinary high-water mark. The latter represents the jurisdictional limit of the Michigan Shore-

lands Protection and Management Act. Further extensions of this boundary were made to include coastal lakes, river mouths and bays, floodplains, wetlands, Great Lakes sand dunes; public recreation and natural areas; and heavily developed or urbanized areas.

The program was submitted for approval to the Office of Coastal Zone Management in August 1977. A draft environmental impact statement was issued in November 1977.

Authorities

The Michigan program's authorities will consist of a number of existing State laws and regulations, including the Shorelands Protection and Management Act, the Soil Erosion and Sedimentation Act, the Subdivision Control Act, the Inland Lakes and Streams Act, the Great Lakes Submerged Lands Act, the Natural Rivers Act, the Mineral Wells Act, the Oil and Gas Wells Act, and the Michigan Environmental Protection Act.

The lead agency for program implementation in Michigan will be the Department of Natural Resources, which also exercises the bulk of the authorities. Coordination and consistency of other State agency actions will be achieved through agency participation on the Standing Committee on Shorelands and Water Coordination and through the Michigan Environmental Review Board's review of proposed State actions which may have significant environmental or human implications. The Board will also serve as a framework for resolving conflicts, and is authorized by executive order to recommend that an activity be halted or modified if found environmentally unacceptable.

Minnesota

Federal Funding

Program Preparation (Section 305)

1974:	$ 99,500
1975:	377,000
1976:	
1977:	336,000
Total:	812,500

Current Status

Minnesota is completing its third year of program development under Section 305 funding. The State is trying to complete a program to be submitted to the Office of Coastal Zone Management in May or June 1978. The lead agency is the State Planning Agency. Through a demonstration project grant, Minnesota is focusing efforts on the Duluth-Superior harbor jointly with the State of Wisconsin.

Authorities

Program authorities will include a number of existing State laws and regulations, including the Shorelands Management Act, the Subdivided Land Sales Act, Power Plant Siting Act, the Minnesota Environmental Policy Act, Environmental Rights Act, and Environmental Quality Board Statute, and others. State agency compliance with the program will be required through the Environmental Quality Board's adoption of the program as State policy. The Board has statutory authority to resolve conflicts involving State agencies with regard to programs, regulations, permits, and procedures significantly affecting the environment. The program has encountered stiff local opposition and may not move into a fourth year of development.

Mississippi

Federal Funding

Program Preparation (Section 305)

1974:	$101,564
1975:	240,906
1976:	171,168
1977:	
Total:	513,638

Current Status

Three years of coastal planning in Mississippi have resulted in a program discussion draft prepared by the Mississippi Marine Resources Council including recommendations concerning boundaries, areas of particular concern, and uses subject to management. The program discussion draft is being revised subject to comments by Federal, State and local agencies, and private citizens. The council has been assisted in the preparation of the management program by citizen advisory committees in each of the three coastal counties, and by an intergovernmental relations committee.

Authorities

The Mississippi program requires additional State authority to ensure compliance by State and local agencies in the coastal zone. Building on existing State authority to issue permits regarding publicly-owned wetlands, the Marine Resources Council will propose legislation to the 1978 Mississippi Legislature that will establish coastal goals and policies for all State and local agencies conducting activities in the coastal zone.

New Hampshire

Federal Funding

Program Preparation (Section 305)

1974:	$ 78,000
1975:	120,000
1976:	148,000
1977:	296,000
Total:	642,000

Current Status

As New Hampshire looks toward the January 1978 legislative session, it is concentrating its work program in three major areas: a public participation effort, preparations for legislative hearings, and development of coordination.

Authorities

New legislation was to be submitted in January 1978. A coastal bill was passed by the House and Senate in 1977, but was vetoed by the governor. The legislation, to be reintroduced this year with some modification, contained a three-tiered boundary. The first tier, 1,000 feet from mean high water; the second tier, the coastal municipalities; and a third tier, towns adjacent to coastal towns. The management program placed major implementation responsibility with local governments to manage coastal activities with State assistance.

New Jersey

Federal Funding

Program Preparation (Section 305)

1974:	$ 275,000
1975:	807,750
1976:	690,337
1977:	
Total:	1,773,087

Current Status

Much of the work accomplished during the first 2 years was mandated by the Coastal Area Facility Review Act (CAFRA). In its third year of program development, the State broadened efforts to meet the specific requirements of the Federal coastal management program, including preparation of a draft program for submittal of the CAFRA area (80 percent of the State coast) as a geographical segment. It will begin the environmental impact statement process in 1978.

Authorities

One New Jersey statute, Coastal Area Facility Review Act, together with other State authorities such as a Wetlands Act, constitute the basis for a coastal management program. For the remainder of the State's coastal area, along the Delaware Bay shore, it is possible that new legislation will be needed.

New York

Federal Funding

Program Preparation (Section 305)

1974:	$ 923,000
1975:	
1976:	951,825
1977:	927,800
Total:	2,802,625

Current Status

During 1977 three major activities were accomplished. The tentative statewide boundaries were delineated. Geographical areas of special concern were selected, and preliminary direction of needed legislation was proposed which would place management responsibilities with local governments in a method similar to that under existing wetlands management legislation. The State expects to have a draft program for public review by June 1978.

Authorities

The State has tentatively determined that the additional legislation will be similar to existing State wetlands legislation which uses local governments to implement the program. The legislation will be submitted in January 1979.

North Carolina

Federal Funding

Program Preparation (Section 305)

1974:	$ 300,000
1975:	639,746
1976:	666,337
1977:	742,984
Total:	2,349,067

Current Status

The North Carolina program is in its fourth year of Section 305 program development. The program document was formally submitted in December 1977 to the Office of Coastal Zone Management for environmental impact statement review.

Authorities

The State is basing its program on the North Carolina Coastal Area Management Act (CAMA) of 1974. This State law provides for direct regulation of activities in areas of environmental concern (AECs). Additionally, the Act requires local governments to prepare comprehensive plans in conformance with State guidelines and coastal policies.

In areas outside of AECs, the State will use existing authorities to manage uses that might have a damaging effect on coastal areas or resources. A signed executive order will help facilitate networking of the various State authorities. The order mandates State agency consistency with coastal goals and policies, and directs State agencies to act in a manner consistent with local land use plans where possible.

Ohio

Federal Funding

Program Preparation (Section 305)

1974:	$ 200,000
1975:	
1976:	419,000

1977: $ 600,000
Total: 1,219,000

Estuarine Sanctuary (Section 315)
1977: $894,152
Total: 894,152

Current Status

The Ohio program is in the early stages of its third year of development. The proposed management area for the program currently consists of a 1,000-meter strip of land along the shoreline of Lake Erie. This zone will extend further inland to cover areas that are affected by the lake or which would affect the coastal zone. A final management boundary will not be determined until the organizational structure and program authorities are agreed upon by the government units involved in the program.

Ohio has not yet decided which coastal uses should be managed by the State coastal program. It is likely that the State will want to deal with those which affect coastal water quality and those which could be affected by erosion and flooding. Once the State enters the program implementation phase, Ohio intends to develop incentive projects that will lead to increased public access and port activity. Preliminary statements of goals and objectives by the State indicate that Ohio will attempt to use the coastal program to assist property owners in controlling erosion through identification of other Federal programs that can provide this assistance. The State has also developed a preliminary list of areas from which it will designate special management areas for economic development, cultural preservation, and natural qualities such as fish and wildlife management.

The organizational structure and authorities that the management program will use have not yet been identified. The citizen advisory groups formed during program development and the State agency responsible for program development—the Department of Natural Resources (DNR)—have expressed a preference for keeping program regulatory decisions at the lowest level of government. It appears that Ohio will have to develop strong interagency linkages during program implementation, because some existing authorities at the State level such as air and water quality authorities and the Power Siting Act will be incorporated as part of the program. These authorities are not administered by DNR.

Authorities

It is likely that Ohio will require some form of new State legislation to deal with issues such as shoreline erosion and coastal flooding. All regulatory power over land-use decisions now resides at the local level. Any new authority which is developed in these areas will provide for decision-making at the local level of government. Any State efforts as securing coastal legislation will come early in 1979.

Oregon

Federal Funding

Program Preparation (Section 305)
1974: $ 250,132
1975: 298,811
1976: 1,027,035
1977: 120,000
Total: 1,695,978

Estuarine Sanctuary (Section 315)
1974: $ 823,965
1975: 325,000
1976: 600,000
1977: 55,848
Total: 1,804,813

Program Management (Section 306)
1977: $1,850,000
Total: 1,850,000

Current Status

The Oregon Coastal Management Program was officially approved on May 6, 1977, after a lengthy process and delays caused by the adoption of four new coastal goals for estuarine resources, shorelands, beaches and dunes, and ocean resources. The program consists of direct State control as well as local implementation of statewide goals through the development and implementation of comprehensive land-use plans that are enforceable.

The major emphasis of the program is directed at providing assistance to local governments in developing their comprehensive plans. Much of the assistance revolves around the use of estuarine resources which must be classified according to their capability and suitability of uses. Other work elements include processing petitions for review (enforcement), efforts to improve coordination and consultation, joint participation with the State of Washington including local governments and the involvement of Federal agencies in the comprehensive management of the Columbia River Estuary, and a public awareness program directed at stimulating citizen participation in comprehensive planning.

Authorities

The Federally approved Oregon Coastal Management Program is based on a broader statewide program, namely the Land Use Act of 1973. Other authorities in the program include laws dealing with beaches, dredge and fill, mandatory zoning, and natural area preserves. The Land Conservation and Development Commission and the Department of

Land Conservation and Development administer the program.

Pennsylvania

Federal Funding

Program Preparation (Section 305)

1974:	$150,000
1975:	225,000
1976:	292,000
1977:	
Total:	667,000

Current Status

Pennsylvania is completing its third year of program development. The State has two coastal zones, the Delaware Estuary coastline and the Lake Erie coastline. The Commonwealth is completing work on the organization and authorities element of its third-year grant. This particular element was not properly completed during the grant period, and the Office of Coastal Zone Management found that the Commonwealth has not made satisfactory progress. At the start of 1978, no further funds were budgeted for the Commonwealth.

Authorities

Legislation will be needed in Pennsylvania in order to meet the requirements of the national coastal program.

Puerto Rico

Federal Funding

Program Preparation (Section 305)

1974:	$ 250,000
1975:	350,000
1976:	424,190
1977:	334,653
Total:	1,358,843

Program Managament (Section 306)

1977:	$292,626
Total:	292,626

Current Status

Puerto Rico is in its fourth year of coastal program development for the whole Commonwealth, having received Federal approval for a management plan for the Culebra Segment in April 1977. During this last year, the Department of Natural Resources has begun its formal public review and informal Federal review of its management program. Public hearings were held in January 1978, and the environmental impact statement process was expected to begin in April 1978. In addition, the Commonwealth continues to refine work being done to enable it to gain Federal approval of its entire plan for comprehensive coastal management, anticipated in August 1978.

Authorities

The Puerto Rico Planning Board is given broad authority for controlling land and water uses. Island-wide policies have been adopted as part of the Island-wide Land Use Plan and specific coastal policies will be adopted for the program submitted for Federal approval. The Department of Natural Resources will be the designated State agency and will assist the Planning Board in implementing the program.

Rhode Island

Federal Funding

Program Preparation (Section 305)

1974:	$ 154,415
1975:	422,840
1976:	430,779
1977:	624,000
Total:	1,632,034

Current Status

After about 6 years of experience in coastal resources management and 4 years of management planning with Federal coastal program assistance, the Rhode Island Coastal Zone Management Program was submitted to the Federal Government in October 1977. There have been opportunities for public and private review of the draft program, and the University of Rhode Island Coastal Resources Center has prepared documents describing the programs. Hearings on the draft environmental impact statement on the program plan were held in 1977, and final approval of the program is anticipated in 1978.

Authorities

The State program is being based on 1971 legislation establishing the Coastal Resources Management Council. To provide specificity, 21 regulations have since been adopted. The governor's office has been designated the Section 306 management agency.

South Carolina

Federal Funding

Program Preparation (Section 305)

1974:	$ 198,485
1975:	281,664.82
1976:	522,314
1977:	335,000
Total:	1,337,463.82

Current Status

South Carolina began its fourth year of program development on October 1, 1977. During the third grant year, the State signed into law the Coastal Management Act of 1977.

A draft paper on geographic areas of particular concern was produced this past grant year. The draft defines standards and criteria for four area categories, and specific sites will be identified with these criteria. The draft also produced a description of existing State laws that affect coastal areas. An analysis of existing State law will be used to supplement the State Council's management authority. This analysis provides a good basis for the proposed networking mechanisms between the State's Coastal Council and other State agencies.

Authorities

The State legislature in 1977 established the South Carolina Coastal Council and gave it permitting authority in critical areas, namely wetlands, beaches, and dune areas. The State legislature retained a measure of control over the State coastal management effort by requiring submission of the completed program to it for approval. Interim final Rules and Regulations were completed for the South Carolina Coastal Zone Act. The State is now working on identifying gaps in the management authority that must be filled to develop a Federally approved program. During this fourth year of program development, the State will present a draft coastal zone management plan for review. This draft plan will address the Section 305 planning requirements for energy facility planning, shorefront access, and shore erosion planning.

Texas

Federal Funding

Program Preparation (Section 305)

1974:	$ 360,000
1975:	920,000
1976:	1,115,000
1977:	940,996
Total:	3,335,996

Current Status

Texas has begun its fourth year of coastal planning with the preparation of a "Working Paper" on the Texas Coastal Management Program. The "Working Paper" establishes the issues that will be the focus of the Texas program: natural hazards protection, freshwater inflows to bays and estuaries, dredge material placement, industrial and energy siting, and shorefront access. A major part of the Texas program effort is the development and implementation of an activity assessment routine; a systematic process for assessing, in advance, the probable economic, environmental, and social effects of specific activities in the coastal zone. The "Working Paper" has been reviewed by Federal agencies and will be revised into a draft management program. The development of the Texas coastal management program has been the responsibility of the Texas General Land Office with the assistance of a State Advisory Committee.

Authorities

Implementation of the Texas coastal management program will rely primarily on pre-existing State authorities, especially the powers of the General Land Office, and the organizational and acquisition authorities that were enacted during the 1977 legislative session. The recently enacted legislation, which was developed by the Texas coastal management program, included bills creating a Natural Resources Council (NRC) made up of State resource agencies, another bill establishing the coastal coordination responsibilities of the NRC, as well as a Coastal Wetlands Acquisition Act and a Dredged Materials Act.

Virgin Islands

Federal Funding

1974:	$ 90,000
1975:	
1976:	120,000
1977:	180,000
Total:	390,000

Current Status

The Virgin Islands is in its third year of funding for program development. During the early part of this grant year, the Virgin Islands began the formal public review and an informal Federal review of its draft management program. Later in the year, public hearings were held and comprehensive coastal zone management legislation was drafted and submitted to the Senate. At the same time, the Office of Coastal Zone Management began the environmental impact statement review process on the Virgin Islands management program. In September 1977, the legislation failed to pass by one vote. The legislation has been redrafted based on comments from interest groups, legislators, and the coastal zone office. The legislation was to be resubmitted in February 1978.

Authorities

The proposed legislation provides for direct State control of the Virgin Islands coastal zone, a two-tier boundary encompassing the whole of the islands and surrounding territorial islands. Simplified permitting of all development in the first tier, and a set of comprehensive policies on which permit decisions are to be passed. The Department of Conservation and Cultural Affairs will be the implementing agency.

Virginia

Federal Funding

Program Preparation (Section 305)

1974:	$ 251,04[illegible]

1975:	$ 403,520
1976:	
1977:	754,200
Total:	1,408,764

Current Status

Well into its third year of program planning, Virginia has been primarily involved with data collection and public discussions of coastal management. Responsibility for administering the program has changed hands, passing to the Office of Commerce and Resources with dissolution of the Division of State Planning and Community Affairs.

During its third year of program development, Virginia defined its management strategy, procedures, and organizational requirements in a document entitled "Proposals for Coastal Resources Management." The State has held a series of public hearings based on this document and intends to use public comments in developing a legislative package for submission during the 1978 session of the General Assembly.

Authorities

The State is seeking new legislation to meet the standards of the national coastal management program, with submission of legislation scheduled for early 1978. Enactment of this legislation, which may include an amendment to the wetlands law as well as a major facilities siting bill, is not expected until after 1 year of study.

Washington

Federal Funding

Program Preparation (Section 305)

1974:	$ 388,820
1975:	775,000
1976:	
1977:	99,000
Total:	1,262,820

Program Management (Section 306)

1976:	$2,000,000
1977:	1,750,000
Total:	3,750,000

Current Status

Washington has concentrated its first and second year Section 306 funds on enhancing the role of local governments in the areas of program administration and enforcement; revising and refining local master programs; conducting studies in areas of particular concern on issues important to local communities as well as State and Federal agencies; establishing closer Federal agency coordination and designing a conflict resolution mechanism; standardizing coastal resource data through the development of a coastal atlas; and developing model ordinances and guidelines for coastal aquatic areas, the Outer Continental Shelf, and the second tier of the coastal boundaries.

Authorities

The coastal program is based on the Statewide Shoreline Management Act of 1971 and other State authorities.

Wisconsin

Federal Funding

Program Preparation (Section 305)

1974:	$ 208,000
1975:	570,400
1976:	525,760
1977:	
Total:	1,304,160

Current Status

Wisconsin has submitted its program for approval. The draft environmental impact statement was issued in October 1977. Wisconsin is currently undergoing public and Federal agency review of its coastal program. The lead agency in Wisconsin is the Office of State Planning and Energy in the Department of Administration. Wisconsin's coastal zone boundary will be the limits of its 15 coastal counties. Geographic areas of management concern have been designated by generic category, as well as on a site-specific basis. The intial 23 site-specific designations will have a duration of 1 to 3 years, after which they will be reevaluated.

Authorities

Among the 30 authorities which will form the Wisconsin program are the State shorelands program, powerplant transmission line siting provisions, dredge and fill permit authority, soil erosion controls, subdivision, and flood control legislation. These existing authorities will continue to be exercised by three State agencies: Department of Natural Resources, Public Services Commission, and the Department of Transportation. These agencies are bound to act consistently with the Wisconsin coastal policies both by State law and by an executive order issued by Governor Schreiber in October 1977. The executive order also established a Coastal Management Council that will oversee State agency implementation, provision of financial and technical assistance, approval of the program budget, intergovernmental coordination, and coastal management advocacy.

As the first State to have its program approved by the Secretary of Commerce, Washington has established the effective level of Federal acceptability. That is, other States could not reasonably be asked to provide more than Washington. The State has received two administration grants under Section 306, the only State to do so through 1977.

While details of the State's program are peculiar to the specific act on which it is based, the basic dynamics of the Washington program, specifically the State-local government relationship, probably will be representative of those States which gain eventual Federal approval.

Several features of the State of Washington's coastal zone program are basic to understanding how it operates.

First, the coastal zone management program is based on a State Shoreline Management Act[65] covering all major inland rivers and lakes, as well as the saltwater coast.

Second, the "program" consists of individually prepared local master programs by each municipality and county along the coast, developed under broad State guidelines. Each "shoreline master program" reflects the political, social, and economic makeup of the particular jurisdiction.

Third, State intervention in local development decisions, after approving a local master program, is concentrated on the first 200 feet inland. The State is given an opportunity to appeal any local development decision in this area to an independent Shorelines Hearing Board; it does not have the power to overturn such decisions directly. And the jurisdiction of the hearing board does not apply to the land area inland of 200 feet (with exceptions for certain wetlands). Activities beyond the 200-foot line which would affect the coastal area are obliged to meet the goals of the shoreline program, providing an opportunity for more extensive State coverage.

The basic control mechanism operating in the 200-foot coastal area is the requirement that a shoreline permit be obtained from the local government, beyond whatever other permits might be required. Certain activities are exempt from this permit requirement, notably construction by the owner of a single-family house. Homes constructed by a developer for sale would require a permit. The thinking was that single-home construction did not create the qualitative problems prompting adoption of the pregram. Also, the exemption was felt necessary politically.

Implementation of Program

The Washington State program has had three distinct phases. The first was between June 1971 when the State legislature acted and November 1972 when the voters sanctioned shoreline management. The second was between November 1972 and varying times after 1974 when locally prepared master programs for the shorelines were prepared. The third phase, still not reached in a few jurisdictions, is the administration stage when local governments issue the required permits according to the State-approved master program and send the required notice of each such action to the State.

Washington at first funded the shoreline activity entirely by itself, perhaps in anticipation of eventual Federal assistance. The State was one of the first to be funded under the national coastal management program in May 1974. An initial two-thirds Federal grant of $388,820 was followed by a second grant of $774,000 for program development in July 1975. Table 4–7 shows the sequence of major events in the Washington State program as they relate to the timetable of the national coastal management program.

The real beginning of the program can be dated from 1974, when the first locally prepared master program was approved and permits were issued based on it. Once approved, such programs become State law and can only be amended with State approval.

The shoreline management process began with a mandatory inventory of resources by local government units. Generally, the work was performed by existing planning agencies. Of the 15 coastal counties, all had already zoned at least part of their land. Comprehensive plans had been adopted by 89 percent of the coastal cities and 80 percent of the counties. By virtue of the shoreline management requirements of local governments (if a unit failed to produce a plan, the State was empowered to do so), four planning offices were established and one comprehensive plan stimulated.[66]

Following development of the resource inventory, shoreline/coastal programs were developed according to State guidelines which spell out both the timetable and the content required. The original deadline was met by less than 10 percent of the statewide eligible entities; after a 6-month extension granted by the State legislation, half of those eligible submitted master programs.[67] As of November 1977, about 200 cities and counties had completed the

[65] RCW, Chapter 90.58.

[66] Jens Sorensen, Researcher, Institute of Urban and Regional Development, University of California. *State-Local Collaborative Planning: A Growing Trend in Coastal Zone Management.* Office of Coastal Zone Management, NOAA, Washington, D.C., October 1977, pp. 5–55.

[67] Ibid. pp. 5–30.

Table 4-7.—Washington State/National Coastal Management key dates

1971	1972	1973	1974	1975	1976	1977
June Washington Shoreline Management Act passed	**June** Guidelines to local governments issued by Washington Department of Ecology	**December** First funding available for coastal management from NOAA	**April** First local master program approved by Washington State	**March** Washington submits program for approval by NOAA	**June** Washington program approved by Secretary of Commerce; NOAA makes grant of $2 million for program operation	**July** NOAA makes second grant for Washington program operations, $1,750,000
	October Coastal Zone Management Act signed		**May** NOAA makes program development grant of $388,820	**May** NOAA gives "preliminary approval" to Washington program **July** NOAA makes grant of $775,000	**July** Coastal Zone Management Act amendments signed	
	November Washington voters approve shoreline management			**December** Washington resubmits program to NOAA		

program development process out of an eligible 229.[68]

The State instructed the cities and counties to prepare programs with five major elements: citizen involvement, statement of policy, seven planning elements, categorization of shorelines, and provisions for variances. The State suggested designating all shoreline coastal areas as belonging to one of four categories, with future use of the land governed by this designation. In order of restrictiveness, they were: natural, conservation, rural, and urban. Some jurisdictions elaborated on these four basic categories; Seattle, for instance, divides its shoreline into seven areas, containing two types of conservation territory and five subdivisions of the classification "urban." This categorization process has been termed the "keystone" of the approach taken in Washington State.

Localities, naturally, will shape their master programs in accordance with their perceived needs. For some, this means restricting use of the shore by outsiders.[69] Others desiring to promote economic development have made widespread use of the "urban" classification of their shores to permit the maximum amount of future expansion, and have placed the "conservation" and "natural" classifications on relatively few privately owned lands.

The negotiating process between State and local officials is essentially a political one, where the State coastal program office attempts to achieve as many of its objectives as it can and local governments pursue their interests to the maximum extent. How effective the process is depends on expectations. To the extent that any alteration of a locally prepared master program is achieved, the State program could be judged successful. Or the same process could be looked at and judged inadequate because the local unit of government has made most of the decisions about future shore use.

Characteristics of Program

The following characteristics typify the coastal management program in Washington:

- The program is dominated by local units of government, the coastal cities and counties. The State Department of Ecology, which administers the program from Olympia, knows it cannot force unpopular policies on a local government and that it is constrained in its ability to persuade a local unit to alter a policy. A University of California researcher who has looked at the program reports that the State has decided to let communities adopt programs which, while flawed from the standpoint of State objectives, enjoy popu-

[68] Communication from Washington Department of Ecology, November 13, 1977.

[69] Jens Sorensen, op. cit. note 66, pp. 5–34.

lar support. As a consequence, locally prepared coastal "master programs" which initially were rejected by the State were approved after informal negotiations on the second submission, whether or not all of the imperfections were corrected.[69a, 70]

• A limitation of the program is its basic 200-foot coverage. Except for special wetlands and floodplains, prime coverage of the Shoreline Management Act of 1971 on which the coastal management program is based is limited to the first 200 feet inland. The State is trying to persuade counties and cities to bring their plans for the rest of the coastal area into conformity with the objectives set out for the 200-foot zone. The initial proposal by environmentalists was for a 500-foot zone.

• Two important exemptions from the requirement that a permit be obtained for development within the 200-foot zone are owner-built, single-family homes and bulkhead installations, as noted above. Two researchers at the University of Washington found that single-family homes constituted one half of the development around Puget Sound. They also found that 90 percent of the work on Puget Sound shoreline bulkheads was proceeding without a special shoreline permit.[71]

• Nine of the 15 coastal counties, mostly small and rural, voted against shoreline management in a 1972 referendum. Higher levels of noncompliance with the program's permit requirement and more extensive use of the most permissive category for the coast (the designation "urban") are found in these counties.

• Twenty-five percent of the State's coast has been designated an area of Statewide significance, which means local governments must abide by specific State policies for the types of uses to be permitted in these areas. Local governments, however, sometimes use the shoreline use categorization process to thwart State objectives in recreation or for providing more public access.[72] One place where the State objective of opening up access to the shore has been successful is with the Port of Seattle, which reports that the most significant impact of the shoreline act was to encourage access points for the public in port projects.[73] Generally, the question of access is a balancing act between preservation and development interests and State and local perspectives; some State departments are seen as too development-minded by local governments, which use shoreline management as a bargaining tool vis-a-vis the State.

• The program is credited with preventing some of the more egregious proposals for use of the coast from surfacing.[74] Also, fewer overwater projects are being built along the coast.[75]

• The program has succeeded in getting more attention for shoreline impacts at the local level than would be likely without it.

• Enforcement of shoreline permits is a problem. There is only one full-time enforcement person in the City of Seattle to ensure that shoreline permit conditions are being met; that person will not be employed in this capacity after 1977 and the function will be absorbed by the Building Department. An estimated 20 percent of shoreline permit conditions are ignored.[76] More difficult to determine are the number of projects that proceed without a permit. Successful prosecution of a blatant violation of the shoreline permit requirement in King County (Seattle) has improved compliance there.[77]

• The independent Shoreline Hearing Board, to which the State may appeal local zoning actions it disagrees with, has functioned successfully. Its chosen method of operation is to search for compromise, obtaining thereby a scaled-down development proposal. The State is exercising the option to appeal in limited numbers—102 of the first 3,242 permits.[78]

• Coastal Zone Management Office funding has a significant impact on local governments. The State is passing through $625,000 this year, meaning that a considerable amount of local administrators' time can be given to coastal matters.

• Environmentalists would like to see a stronger hand taken by the Department of Ecology, although they recognize the political difficulties involved. Other issues have come to the fore, such as the question of supertankers in Puget Sound, to occupy the relatively limited resources possessed by environmentalists since the height of coastal zone management activity in the early 1970s.[79]

69a Ibid., pp. 5–55.

70 Darrel Peeples, assistant attorney general, State of Washington. "Recreation: Marine Promise." NOAA Conference on Marine Recreation, Los Angeles, University of California, 1975, pp. 148.

71 Maureen McCrea and Jim Feldman. *Washington State Shoreline Management: An Interim Assessment.* Program in Social Management and of Technology, University of Washington, University of Washington, Seattle, 1976, pp. xx.

72 Interview September 12, 1977, with Al O'Donnell, Washington Department of Natural Resources, and David Heiser, State Parks and Recreation Commission. Also, memo from State Parks Commissioner Charles Odegaard to Governor Daniel Evans, May 27, 1976.

73 Interview, September 13, 1977, Art Yashiaka and Keith Christian, Port of Seattle Planning and Research Department.

74 Conversations with Nancy Thomas, president, Washington Environmental Council, and Dennis Derickson, planner, Snohomish County, September 13, 1977.

75 Maureen McCrea and Jim Feldman, op. cit. note 72, p. 70.

76 Interview, September 13, 1977, Rosemary Horwood, planner, Seattle Department of Community Development.

77 Jens Sorensen, op. cit. note 66, pp. 5–69.

78 Maureen McCrea and Jim Feldman, op. cit. note 72, p. 70.

79 Interview, September 13, 1977, with Nancy Thomas, president, Washington Environmental Council (consisting of 70 member organizations).

• Citizen participation in preparation of the local master programs has been extensive and is regarded as one of the strong points of the State program.

• The program has led to attempts to deal with regional resource issues, such as a bay bordered by a number of jurisdictions and the Columbia River, also traversing several local governments.

• The Washington State coastal program has sponsored an ambitious atlas providing detailed maps of the coastal area for use by local governments and others.

Evaluation Criteria

In order to evaluate the coastal zone management programs, it will be necessary to examine in detail individual State programs. There is general agreement that the merit of the individual State programs will be the key to the overall success or failure of the coastal management effort, not the number of State programs given approval and continued funding.

Evaluations should concentrate on those features of the intrastate and State-local governmental process that provide a meaningful picture of how the coastal zone management program is working in practice. State programs should be examined for the following types of information:

• Determine the location and size (fulltime personnel) of the State coastal zone management program office; the rank of the executive who is managing the program on a day-to-day basis; compare with water quality program office;

• Ascertain the reporting layers between the coastal zone program office and the governor's office; if possible get an indication of the amount of interest in the program on the part of the governor;

• Determine the number of outside interest groups commenting in detail during the formulation of State programs and on environmental impact statements;

• Determine the amount of legislative interest (actual votes, hearings, inquiries from legislators, or other expressions of interest); the extent to which coastal zone management is a public issue (by checking newspaper files for coverage);

• Determine which major State coastal issues and controversies were handled by the coastal zone office and which were referred elsewhere in the State government;

• Survey State line agencies (highways, recreation, natural resources, port authorities, and others) for changes they have instituted as a result of coastal zone management policies; that is, what changes in procedure they attribute to coastal management policies;

• Determine the State/local permit issuing process for key coastal activities such as wetland alteration, bulkhead construction, dune alteration, marina construction, or condominium construction, how it was done previously and how it is done after adoption of a coastal zone management program; describe the impact of the changes on an individual applicant for one or more of the State permits, step-by-step;

• Examine "memos of understanding" or other means used by the State coastal zone office to influence other State agencies' day-to-day operations; obtain an opinion of the legal standing of the instruments;

• Determine the amount of new data that has been assembled by State (and local) coastal program offices; determine how much existing data has been transformed to usable information;

• Survey a sample of local governments for changes in zoning permit decision-making brought about as a result of coastal zone management policies; find out what additional steps or considerations are involved because of the program, and how they are institutionalized;

• Obtain the views of diverse interest groups about the effectiveness of the program and the degree of change it has brought about;

• Examine State coastal zone office expenditures by general category: personnel (permanent and temporary), travel, research, consultants, mapping, pass-through to local governments, and

• Learn if any use is made of the Federal consistency provision of the Act, determine what change in a Federal agency action was required as a result.

Preliminary evaluations indicate that delays in program implementation are probably due to inherent problems in program design rather than to faulty administration. Three problems in program design have been identified: (1) difficulty with effective land-use planning and zoning, particularly that requiring local government to relinquish powers; (2) absence of positive incentives for State and local participation, since the program is voluntary (as for the promise of "Federal consistency," GAO found that States are concerned that the provisions will be "gutted" by Federal interagency agreements); and, (3) planning is generally a low-level operation in the States, and there is a tendency to want to study forever.

While inherent difficulties are felt to be primarily responsible for the longer-than-expected development of the program, administration by the Office of Coastal Zone Management has not escaped criticism. Among them are:

• Inconsistency of direction to the State program managers; in other words, shifting directions from

Washington make it hard for State program managers to know which direction to pursue;

- Failure to sustain a technical information service valuable to the States; and
- Lack of close monitoring during development of State programs, as opposed to providing support.

The program is at a critical juncture. Because of the inherent difficulties embodied in the coastal zone management program as designed 7 years ago, and as discussed in the background and implementation sections, a difficult choice faces the program: should relatively weak programs be approved, on the grounds that they are the most effective that can reasonably be expected, or should the Office of Coastal Zone Management/NOAA and the Department of Commerce insist on programs matching the original ambitious design?

There is a direct parallel to this question in the States. As seen in the discussion of the Washington State program, the State-local relationship is a mirror image of the Federal-State relationship as described here.

An argument in favor of approving relatively weak State programs is that the continued Federal involvement, through program operation funding (Section 306), provides an opportunity to encourage States to meet national objectives in the coastal region through this program and its relationship to other, ongoing State authorities. To do otherwise, according to this line of reasoning, means cutting off any chance for the foreseeable future of using the coastal zone management approach to protect national interest goals in the coast.

The coastal zone office has chosen to make every effort to insist on as much authority as it can from State agencies to control future coastal activities—and to get as many "approvable" programs as possible. The dilemma facing the program is the balance between wanting the strongest possible State management programs on the one hand, and the practical, political difficulties of bringing effective management programs into being on the other.

Alternative Approaches to Coastal Zone Management

During the 1978 assessment of the coastal zone management effort—whatever the resulting judgment as to the program's effectiveness—it would seem appropriate to look at alternative approaches. If the judgment is that the current approach is effective or is likely to be in time, it will nonetheless be instructive to look at other possible methods of dealing with the problems of coastal resource use. If it is judged that the current Federal grant-in-aid program is not working, and that the problems identified in the early 1970s are still present, then it is incumbent that some alternative approach or combination of methods be suggested for adoption to achieve wise coastal resource use. In that spirit, the following alternatives are put forward for discussion purposes.

The point of departure is the fundamental precept of coastal zone management itself. Are the original objectives of the Act—to protect coastal land and water resources for their best use by controlling development of the area at the State level of government—still valid? Has the national outlook changed since 1972 to the extent that a new national objective for the coastal region should be redefined? Or, do the methods of achieving the objectives need reexamination? Possible alternatives follow.

- *Either Phase Out Federal Support of Coastal Zone Management Over 5 to 7 Years or Continue for 10 Years.*

It has been suggested that NOAA might gradually phase out matching funding support to the States for program operation, from the present 80 percent to 20 percent in fiscal year 1983 and presumably zero a year or two after that.

The rationale for this suggestion is that the Federal Government will have provided States and local communities enough opportunity by fiscal year 1984 or 1985 in what is considered by some to be essentially a State-local matter, i.e., control of the uses of land and water. This argument holds that the millions of dollars in Federal aid which will have been expended by then will have helped the States marshal the scientific and technical information needed to make sound decisions and will have provided them with sufficient impetus to assume the full responsibility for coastal protection.

In many, if not most, States, withdrawal of Federal matching aid would either mean the end of the coastal planning and management activity as a separate initiative, or at best, a sharp reduction in resources available for this effort both at the State and local level.

The States and Nation would risk the loss of the technical competence assembled by the States under this option if there were a cutback or abandonment of the coastal management initiative. Some suggest, however, that a cutback would improve the quality of effort by weeding out lower priority activity.

In arguing against a phase-out of Federal funding, the Office of Coastal Zone Management has stated that a phase-out by the mid-1980s would be "reneging" on an implied agreement; would compel States to stop their efforts before obtaining operating management programs; would be inconsistent with the action of Congress in 1976 by adding substantially to the program; and, last, would still cost a total of $185 million by fiscal year 1985 with much of that investment lost for the future.

The difficulty with the phase-out approach is that it leaves the coastal resource problem in large measure as it was identified in the late 1960s and early 1970s, except that the pressures for development have intensified in many areas.

One alternative of a totally differing nature would be to stretch out Federal support, that is, recognize the difficulties some States are having in developing comprehensive management programs and provide continued development support for, say, 10 years. This, of course, would require a continuation of the authorization for Section 305 support now due to expire at the end of fiscal year 1979. This option would leave open the question of how long, and on what basis, program operation funding (Section 306) might continue.

- *Continue Funding Matching Section 306 Grants at a Reduced Rate*

This recommendation is based on a distinction between State and national interests in the coastal area. The assumption is that the States will be willing to assume their responsibilities and fund a larger portion of Federally approved coastal zone management programs which qualify for administrative grants than the present 20 percent. Continued Federal funding at a lower percentage would ensure that the State perform those tasks deemed in the national interest, which they might otherwise not undertake. These include facility-siting decisions, operation of the "Federal consistency" section of the program, wetland protection, and efforts to reduce disaster damage.

It is not clear how the differential between strictly State functions and the national interest portion would be determined. Nor is there at present a clear indication of the amount of money needed for this support.

This alternative does not address the question of the value of the approved programs in improving coastal use decisions. It *assumes* that there will be a large number of effective State programs, which will have the ability to control use of land and water in the coastal region.

With regard to such national interest questions as protection of wetlands or other valuable coastal areas, the question is whether the coastal zone management approach is the most cost-effective means or whether other methods would be more efficient. The same holds true for other national interests such as port modernization, energy plant construction, and disaster damage reduction.

- *Replace Reliance Upon Zoning and Permit Issuance With Outright Acquisition*

Acquisition of critical areas of concern would be a costly option. But there are possible alternative funding measures which would preclude the need for massive appropriations that could be used to protect especially valuable coastal areas.

For example, existing Federal land purchase assistance programs could be amended to ensure that a fixed percentage is used in coastal regions. The Land and Water Conservation Fund, administered by the Heritage Conservation and Recreation Service, which receives a portion of its funds from offshore oil and gas operations, could be directed to apply a percentage of its matching grants for coastal recreation.

Some of the other programs already used to protect coastal areas might be increased or concentrated in coastal areas if it were determined to be in the national interest. Examples include the Water Bank Act and Soil Conservation and Domestic Allotment Act in the Agriculture Department, and the Federal Aid in Sport Fishing Restoration Act (Dingell-Johnson Program) and Federal Aid in Wildlife Restoration Act (Pittman-Robertson Program) in the Department of the Interior. Assistance from disparate agencies such as the Economic Development Administration in the Department of Commerce and the Department of Housing and Urban Development also could contribute to the protection of coastal resources.

President Carter identified coastal wetlands (as well as inland bodies) and coastal barrier islands as two resources to be protected by the Federal Government in his May 23, 1977, environmental message. He issued an executive order barring agencies from taking actions leading to wetlands development and has requested recommendations on how to protect the remaining undeveloped barrier islands of the Atlantic and Gulf Coasts.

The value of certain coastal resources is such that reliance on a zoning-permit program may not always be sufficient to withstand the tremendous pressures for developing coastal properties. In addition to the Administration's proposed initiatives, it may be appropriate to examine the utility of a broader "coastal resource conservancy" program that could consolidate existing and proposed coastal acquisition and regulatory activities and perhaps add authority where needed to provide sufficient coverage to protect resources having national significance. Federal action could come in the form of payment to property owners to restrict development (purchase development rights), as in the Water Bank Act (for wildlife habitat protection), and thus avoid the high cost of buying coastal territory outright. Such a program could use the information developed in the coastal management effort to identify and rank the most valuable coastal features in danger of development as candidates for "coastal resource conservancy" assistance. Other resources could be protected by regulation such as wetlands now are. The fund

could be used in combatting shore erosion or assisting in harbor restoration projects.

This approach would allow effective control of a wide range of valuable coastal features, such as coral, dunes, intertidal areas, islands, or wetlands.

- *Develop a Series of Special Assistance Programs Within the Framework of CZMA*

The grants available for purchase of estuarine sanctuaries are in this category, as is the authorization for acquisition of islands and access ways to publicly held coastal attractions (Section 315(2) of the Act). Similarly, the coastal energy impact assistance in Section 308 of the Act is a special assistance program.

Proposed in addition by the coastal office is a "coastal fishery management program," aimed at bringing about coordinated, interstate management of fishery habitats in the coast. The specific proposal is to provide funds through the new interstate grant authorization (Section 309) to the Regional Fishery Management Councils set up under the Fishery Conservation and Management Act of 1976. An underlying purpose of the fishery proposal, as with the energy impact assistance, is to provide an incentive for States to produce good coastal management programs in order to qualify for the extra aid.

Legislation has been introduced proposing Federal assistance through the coastal zone management program to help States and communities deal with erosion problems, which are particularly important in the Great Lakes States.

- *Pinpoint Specific Areas of Critical Concern for Special Protective Measures*

Another approach would involve identifying those features whose retention in an undeveloped, or nearly undeveloped, condition is in the national interest: barrier islands, dunes, or wetlands, for example. Under this proposal, the Federal Government would direct the States and local governments, through regulations, to develop effective means of providing necessary controls over these specified areas if sufficient control did not exist. After a certain period of time, if the Federal Government found that the State-local governments had not developed regulations or other means of control sufficient to protect the national interest, the Federal Government would take measures to ensure protection of the areas. Such preemption would, of course, cause controversy. The proposal should also include a mechanism for selecting coastal areas suitable for development.

This approach deviates significantly from the existing coastal zone management effort. The existing program attempts to be comprehensive, i.e., provide policy for control over all significant use of coastal land and water resources for both protection and development purposes. This alternative would abandon the comprehensive approach in favor of one focusing on the particular natural features of each area whose preservation or protection is important to the nation, and which selects prime development sites suitable for industrial and commercial development. The States and local governments would be given the opportunity to devise their own means of providing this protection and, failing that, the Federal Government would intercede. Resources requiring special protection would range from beaches to dunes, shellfish beds, coral reefs, bluffs, salt marshes, or islands.

This approach could be built on the present coastal zone management program. After internal debate on the issue, the Office of Coastal Zone Management determined that the program act did not permit functional segmentation, by which States would be assisted in dealing with particular coastal resource problems. Instead, the regulations were written to permit geographic segmentation only where complete programs are required for a section of a State's coast. There is some thinking in the coastal management community that the basic Act does in fact permit a functional segmentation approach and that for some States at least it might be both a politically easier and more effective way to proceed.

- *Recognize the Primacy of Local Control and Base a Coastal Zone Program on Local Governments*

This would recognize the reality that land-use planning and management in this country remains a basic local government responsibility and that any attempt by the States to recoup any degree of this jealously protected authority is difficult. Without major trade-offs, cities and counties are unlikely to relinquish any real measure of their self-determination to those they perceive as a group of State bureaucrats.

Using a combination of building, health, subdivision, and zoning controls, there is little doubt that cities and counties *could* effectively guide and control development in a manner which would protect coastal resources. The problem is that such controls may well not be in the economic self-interest of the local community, at least in the short run. An economic incentive is needed to persuade communities to protect critical coastal resources and guide development effectively, or in the alternative, a negative incentive. Positive incentives could include a credit based on local property tax revenues designed to compensate a community for restraining development in coastal regions, a step which might reduce its potential revenues. This would raise problems in administration.

Protection of Coastal Wetlands

Barrier islands, beaches, coral reefs and wetlands are important habitats for fish and wildlife, protection against storm surges, and features enjoyed for their recreational value and beauty. Recently, these coastal features have been considered as national assets to be protected and preserved. This has not always been the case. In fact, early in the Nation's history it was Federal policy to transform coastal wetlands into "usable" real estate. The Swamp Land Acts of 1849, 1859, and 1860 ceded 65 million acres of wetlands to the States for reclamation.[80] The Department of Agriculture encouraged agricultural purposes until well into this century.

Only recently, beginning in the early 1960s, did the public attitude toward wetlands change. Symbolizing this change in attitude, these productive, low-lying coastal lands are now termed "wetlands," whereas they were commonly referred to as "swamps" and "bogs" in the past. Drainage of wetlands has been curtailed. The Soil Conservation Service of the Department of Agriculture no longer provides assistance for wetland drainage, except in extraordinary cases.[81]

[80] Council on Environmental Quality. "Our Nation's Wetlands." Draft manuscript. Washington, D.C., 1977, p. 51.

[81] Ibid., p. 70.

Pressures From New Development

Recently, new threats to wetlands have emerged. The former major threat from drainage for agricultural purposes has been replaced by the adverse impacts resulting from residential construction, commercial development (e.g., marinas, airports and industry), and use for solid waste disposal. Notwithstanding the change in public attitude toward coastal wetlands, they continue to disappear at a rate of about 300,000 acres per year.[82]

The extent of wetland losses over the distant past is unknown. The best available estimate of the original wetlands in the Nation places the total at about 127 million acres. An extensive survey performed in 1954 by the Fish and Wildlife Service of the Department of the Interior estimated the total then at 82 million acres (not including Alaska and Hawaii)—a loss of 45 million acres or 35 percent of the area.[83]

Some areas have suffered significant losses. For example, the San Francisco Bay Conservation and Development Commission determined that the Bay has shrunk from 680 square miles to about 400 square miles due to filling of marshes and wetlands.

Much of the impetus for protecting wetlands has come from the conservation movement. Fishing people, hunters, and naturalists with an interest in wildlife have prompted the preservation of wetland habitats. In conjunction with the general environmental movement, this has led to a concerted effort to protect wetlands at both the State and Federal levels.

The current working definition of wetlands, developed by the U.S. Army Corps of Engineers in conjunction with the Departments of the Interior and Agriculture and the Environmental Protection Agency,[84] is

> "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that, under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

The Fish and Wildlife Service, working currently on a new inventory of wetland resources, has classified 20 varieties of wetlands, including saltwater marshes, freshwater marshes, swamps, wet meadows, bogs, fens, and potholes. The Fish and Wildlife Service observes that while saltwater marshes are particularly valuable and of major national concern, they comprise only 10 percent of the total national wetlands.[85]

[82] U.S. Office of the President, *President's Environmental Message*, May 23, 1977, p. 13.

[83] U.S. Council on Environmental Quality, op. cit. note 80, p. 83.

[84] U.S. Army Corps of Engineers. "Regulatory Program of the Corps of Engineers," *Federal Register*, Vol. 42, No. 138, Part II, July 19, 1977, p. 37128.

[85] U.S. Department of the Interior, Fish and Wildlife Service. *Wetlands of the United States*, Circular 39, Washington, D.C., 1956.

Importance of Wetlands

Coastal wetlands perform a number of valuable functions. They are a prime source of food for a variety of finfish, shellfish, and wildlife. The productivity of wetlands has been estimated at more than 10 tons of organic matter per acre per year—this exceeds the average production of rich farmland.[86] High productivity is due to the unique position of wetlands, which are enriched by the flow of fresh-

[86] U.S. Council on Environmental Quality, op. cit. note 80, p. 25.

water and subject to daily tidal flooding by saltwater. Freshwaters bring minerals and nutrients; seawater circulates and mixes the nutrients.

Because of the natural mixing, the estuarine environment where wetlands are located produces a variety of living organisms, from microscopic species to large numbers of fish and shellfish, birds, and animals. Many species, such as clams and oysters, spend their entire life cycles in the estuaries. Others, particularly very young shrimp, migrate from the sea to estuarine nursery areas. In these rich waters they grow to subadult size before returning to the sea to complete their life cycles. The anadromous species such as salmon and striped bass, pass through the estuaries to their spawning grounds farther upstream, and the young return through the estuaries to the ocean. At least two thirds of the animal population of the ocean spends an essential portion of their life cycles in estuarine waters or depend on species that do. Waterfowl use wetlands as nesting and feeding areas, as do marsh-dwelling mammals.

Wetlands perform a number of physical functions and chemical processes that have an intrinsic value. They store and slow the velocity of flood waters and high tides, thus protecting shorelands. Wetlands also absorb the energy of hurricanes and storm surges. Because wetlands can assimilate and retain nutrients, they serve as natural filters for nominal amounts of waterborne pollutants. Wetlands also increase the oxygen content of water as it passes through the ecosystem and reduce the nutrient loads carried by transient waters.

The economic value of wetlands is impossible to quantify, although dollar values can be assigned to particular edible products such as shellfish. The production of fish or wildlife, which are common property resources, accrues to society as a whole; the filling of a marsh for commercial purposes brings economic return to the owner of the private property, and perhaps a secondary return to society as well. The inability to balance long-term, societal benefits (fish and wildlife production, hazard protection, and pollution filtration) against immediate, tangible economic returns has led to the destruction of wetlands and underscores the pressures to dredge or fill remaining wetland areas. Inflated property values, which continue to increase rapidly as available coastal land becomes scarce, is adding to the developmental pressures. The creation of "new land" by filling coastal marshes, while expensive, is a relatively cheap means of creating additional real estate.

Efforts to Protect Coastal Wetlands

Federal Wetland Protection

The initial effort toward wetland protection at the national level was in 1967 when legislation was introduced in the Congress to authorize the Secretary of the Interior to veto projects that would damage wetlands. Opposition to this proposal led to compromise legislation (Title 16 U.S.C. 1221–1226) which directed the Department of the Interior to make a National Estuary Study, which was completed in 1970.[87] A parallel study on estuarine pollution was made by the Federal Water Pollution Control Administration in the Department of the Interior at about the same time.[88]

Rivers and Harbors Act of 1899 (Expanded Review)

A major change in the Federal role with regard to wetlands occurred in 1968 when the U.S. Army Corps of Engineers broadened the basis of its review of permits for dredging, filling, and the erection of other structures on navigable waters under Section 10 of the Rivers and Harbors Act of 1899 (Title 33 U.S.C. 401 et seq.) from strictly navigational considerations to broader ecological concerns. The expanded review process, known as the "public interest review" was [89]

> ". . . adopted in response to a growing national concern for environmental values as they related to our Nation's water resources and in response to related Federal legislation, such as the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) that required the consideration of some of these concerns in Federal decision-making."

Although the Corps considered a broad range of environmental factors in the public interest review, it restricted its permit coverage to "navigable waters" of the United States. This definition narrowed the Corps' control over dredge and fill operations to only 15 percent of the Nation's wetlands.[90] The expanded public interest review procedure was upheld by the court in *Zabel v. Tabb* [430 F. 2d 199 (5th Cir., 1970); *cert. denied* 401 U.S. 910 (1971)] upon the denial of a landfill on the grounds that it would damage fish and wildlife. In 1972, the Corps expanded its definition of "navigable waters" to include waters subject to tidal action.

---

[87] U.S. Department of the Interior. *The National Estuary Study*. Washington, D.C., Government Printing Office, 1970.

[88] U.S. Department of the Interior, Federal Water Pollution Control Administration. *The National Estuarine Pollution Study*. Washington, D.C., Government Printing Office, 1969.

[89] U.S. Army Corps of Engineers, op. cit. note 84, p. 37122.

[90] P. S. Ward. "Section 404: A Controversial Program that Grew Like Topsy," *Journal of the Water Pollution Control Federation*, Washington, D.C., May 1977, p. 730.

Federal Water Pollution Control Act Amendments of 1972

The Federal Water Pollution Control Act Amendments were enacted with the objective of restoring and maintaining the quality of the Nation's waters through regulation of the release of pollutants at the point of origin. Section 404 of the FWPCA establishes a permit program, administered by the U.S. Army Corps of Engineers, to regulate the discharge of dredged or fill material into "navigable waters." Wetlands had been the major repository for these materials.

The Corps continued to restrict the coverage of the new Section 404 permit authority to the definition of "navigable waters" which it had adopted under the Section 10 program of the Rivers and Harbors Act. A suit, brought by the Natural Resources Defense Council and the National Wildlife Federation, resulted in a decision requiring the Corps to institute a dredge/fill permit program in all the "waters of the United States," as defined in the FWPCA—an interpretation much broader than "navigable waters" under the original definition.[91]

In interim final regulations published in 1975, the Corps defined navigable waters [92] to include

> "Coastal waters, wetlands, mudflats, swamps, and similar areas; freshwater lakes, rivers and streams that were used in the past or are susceptible to use to transport interstate commerce, including all tributaries to these waters; certain specified intrastate waters, the pollution of which would affect interstate commerce; and freshwater wetlands, including marshes, shallows, swamps and similar areas that are contiguous or adjacent to the above described lakes, rivers and streams, and that are periodically inundated and normally characterized by the prevalence of vegetation that requires saturated soil conditions for growth and reproduction."

This definition was sustained in subsequent court decisions.[93]

The U.S. Army Corps of Engineers' gradual expansion of its permit authority, first in the scope of review of permit applications, and later on the waters to which it applies, was not a linear progression. In 1975, the Corps issued a press release which included an announcement that Federal permits may be required by the rancher who wants to enlarge the stock pond, or the farmer who wants to deepen an irrigation ditch or plow a field, or the mountaineer who wants to protect land against storm erosion.

Opposition to the enlarged Corps' permit program from agricultural interests was swift. The Secretary of Agriculture, Earl Butz, further raised the spectre that "millions of people" might be fined and imprisoned. Suspicions of the Section 404 program within the agricultural community remain today and are reflected in several legislative proposals before the 94th and 95th Congresses to exclude most agricultural and forestry operations from coverage by the permit program.

The Corps proposed to implement the expanded charter under the FWPCA in three stages: Stage one would cover traditional navigable waters and nearby wetlands—those areas which were covered by the Section 10 program under the Rivers and Harbors Act. Stage two expanded coverage to primary tributaries, navigable streams, and all lakes, beginning in September 1976. The third and final phase began in July 1977, extending coverage to all remaining waters.

The operational definition of the areas covered by the Corps' permit programs, which were issued in the final regulations on July 19, 1977, include all "waters of the United States" as specified in the FWPCA, and distinguishes the Section 404 dredge and fill permits from the dam and construction permits required for navigable waters in the Rivers and Harbors Act.

There have been two responses to the outcry that greeted the prospect that ordinary farming activities would be subject to a Corps of Engineers permit: First, the Corps has instituted a "general permit program" authorizing minor discharges for which individual permits are not needed, e.g., shore protection, highway projects, logging roads, erosion control, minor buried pipeline crossings, boat ramps, mosquito ditches, bulkheads, highway maintenance, culverts and other stream crossing structures, fishing reefs, summer dams for water conservation, and trenching.[94] Second, the Corps announced the issuance of "nationwide permits," which exempt certain smaller water bodies and certain types of discharge from the individual permit requirement.

Congress recently reviewed the current Corps permit program dealing with dredge or fill materials. In the 94th Congress, the House of Representatives adopted an amendment to the FWPCA that proposed to restrict the coverage of the permit program. The Senate adopted a different version; the two

[91] NRDC v. Callaway, 392 F. Supp. 682 (D.D.C. 1975).
[92] U.S., Army Corps of Engineers, op. cit. note 84, p. 37124.
[93] U.S. vs. Holland, 373, F. Supp. 665 (M.D. Fla., 1974) et seq.

[94] U.S., Environmental Protection Agency, Fact Sheet, "Implementing Section 404 of P.L. 92-500," spring 1977, p. 2. Although initially misunderstood by many, the present program does not regulate normal farming, ranching, and forestry practices that do not involve discharges of dredged or fill materials into waters of the United States. Thus, the program does not apply to such activities as plowing, seeding, cultivating, and harvesting for the production of food, fiber, and forest products.

bodies were unable to agree in the Conference Committee, and the 94th Congress adjourned without taking final action on the amendments.

Recent amendments to Section 404 of the FWPCA enacted by the 95th Congress (Clean Water Act of 1977) provide for increased State determination of normal farming, silvicultural, and mining activities and also for the issuance of general, regional, or national wetland management permits.[95] The amendment conforms to the recommendations of President Carter in his environmental message to allow States to "assume responsibility for carrying out major portions of this [Section 404] program." [96]

The amendments to Section 404 also exempt Federal projects from the permit requirements if the project is undertaken solely by the Federal Government, subject to procedural limitations. To qualify for exemption from dredge or fill permits, projects must, in addition to being fully funded by the Federal Government, be directly authorized by the Congress. Moreover, an environmental impact statement (EIS) must be submitted to Congress before authorization or appropriation action. The EIS must include a detailed description of all environmental effects expected to result from the project.

Estuarine Sanctuaries (Coastal Zone Management Act)

The Coastal Zone Management Act [Section 315(1)] authorizes the Secretary of Commerce to make matching grants of up to 50 percent to States setting aside estuarine areas for research purposes. The concept is that by keeping a representative number of estuarine areas in natural or near-natural states, field laboratories will be provided to researchers to measure changes in similar, but unprotected, areas.

Five national estuarine sanctuaries were designated at the end of fiscal year 1977. They are:

1) In Florida, the Rookery Bay Sanctuary, totaling 8,500 acres (6,000 acres of which are already protected). It is an example of a West Indian biogeographic region estuary. Federal grant: $1,500,000.

2) In Georgia, a 6,150-acre sanctuary has been established on Sapelo Island. It is a sample of the Carolinian biogeographic area estuary. Two grants totaling $1,550,000 have been made, and acquisition has been completed.

3) A grant of $200,000 has been awarded to Hawaii to assist in acquiring the Waimanu Valley estuary on the north coast of the island of Hawaii. This 5,900-acre sanctuary is representative of the insular biogeographic region.

4) A grant of $894,152 has been made to the State of Ohio to assist with acquisition of the Old Woman's Creek Sanctuary. The 637-acre site will be a sample of a Great Lakes biogeographic region estuary.

5) In Oregon, the South Slough of Coos Bay is the site of a 4,200-acre sanctuary, a sample of the Columbian biogeographic region. Grants totaling $1,804,813 have been made, and acquisition of the land was 74 percent complete at the end of fiscal year 1977.

Both the Sapelo Island and South Slough sanctuaries are considered operational; the other three are in the real estate appraisal stage.

The Coastal Zone Management office projects a total of 18 to 20 different types of estuarine areas in the country as the optimum number needed for acquisition to preserve a sample of each type of estuarine area.

Other Related Federal Statutes

The Fish and Wildlife Coordination Act (Title 16 U.S.C. 661–667a), operating through an interagency agreement, provides for all Corps permit applications to be reviewed by the Fish and Wildlife Service of the Department of the Interior as well as by the Environmental Protection Agency, and the National Oceanic and Atmospheric Administration (NOAA) in the case of permits affecting the marine environment. Any Federal agency's proposed modification of a water resource is subject to review.

The National Environmental Policy Act of 1969 (NEPA) (Title 42 U.S.C. 4321–4347) is landmark legislation that requires Federal agencies to consider all environmental aspects of each permit application, or other "Federal action," and provide for citizen participation and public intervention in the decision-making process.

Three Federal assistance programs have been instrumental in acquiring, protecting, and, in some cases, developing wetlands and beach areas. The Pittman-Robinson Act of 1937, based on a tax on sporting goods earmarked for the States, has been used extensively in coastal States to acquire and protect wetlands. The Fish and Wildlife Service has administered the act. Funds from the Land and Water Conservation Fund have been used for coastal acquisition, protection, and development as well as for developing boat launching areas and access ways, constructing fishing piers, and developing artificial reefs. The Dingell-Johnson program (based on a Federal tax on fishing equipment) has been earmarked for the States and administered also by the Fish and Wildlife Service. It has been used to purchase fish habitats, thereby providing additional wetland protection.

---

[95] U.S. Senate. *Clean Water Act of 1977*. Report. Washington, D.C., Government Printing Office, 1977, pp. 199.

[96] U.S. Office of the President, op. cit. note 82, p. 13.

State Wetland Protection

With responsibility for wetland protection moving toward State administration of dredge and fill activities, the future success of wetland preservation will depend upon the effectiveness with which the coastal States can deal with the conflicting pressures for development on one hand and environmental protection on the other. Local governments view State intervention in land-use matters with equally as much disdain as States have viewed the intervention of the Federal Government. The extent to which the States will be able to manage and resolve the conflicts and effectively protect wetland values is yet to be determined.

Thirteen coastal States have laws specifically protecting wetlands. The first was Massachusetts in 1963. In addition, statutes in 17 coastal States provide some measure of protection for wetlands as part of general environmental or land-use programs.

The 13 States with direct wetland controls are: Connecticut, Delaware, Georgia, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, and Virginia. States having broader multipurpose programs that include wetland protection components are: Alabama, California, Delaware, Florida, Hawaii, Maine, Maryland, Minnesota, New Jersey, North Carolina, Oregon, Rhode Island, South Carolina, Texas, Virginia, Washington, and Wisconsin.[97] In some cases, States have both types of laws.

Sample States which exercise control over the use of wetlands include: Wisconsin, which regulates wetlands through its shoreland zoning act and dredge and fill permits in navigable waters; Oregon, where the State land use program is the vehicle; and Florida, where the Keys are under the protection of a critical area program. The South Carolina Coastal Act, adopted in May 1977, expressly provides a State permit program for wetlands as a key function of its coastal council.

Eleven States provide for direct regulation of wetlands under the State police powers, although there is a current trend to modify this power with more authority being claimed by local governments and municipalities. Generally, the statutes authorize a natural resource or water resource agency to issue permits for specific activities, according to criteria specified in the statute. Another approach, first undertaken by Massachusetts, is to issue administrative orders for specific wetland areas, designating what can and cannot be undertaken in a specific geographical region. If the order is determined by the court to constitute a taking of private property, the State acquires the property in fee under its power of eminent domain or acquires an easement for the area.

Four States (Virginia, Connecticut, New York, and Massachusetts) rely on local governments to administer a permit program to regulate use of wetlands in accordance with State guidelines for minimum standards. State standard-setting for local administration is also featured in the broader multipurpose shoreland and coastal zone acts operating in a number of States which provide wetlands protection, namely California, Maine, Minnesota, North Carolina, and Wisconsin. A listing of State coastal wetland laws follows:

[97] Environmental Law Institute, "Strengthening State Wetland Regulation," Draft manuscript, Appendix A and B. Washington, D.C., 1977.

State	*Statute*	*Citation*
Connecticut	Coastal wetlands	Ch. 440, Sec. 22a–28 to 22a–31
Delaware	Coastal wetlands	Title 7, Sec. 6601 et seq. to
Georgia	Coastal wetlands	Sec. 45–136—45–147
Maine	Coastal wetlands	Title 38, Sec. 471 et seq. Title 12, Sec. 4751 to 4758
Maryland	Coastal wetlands	Title 9, Sec. 9–101 et seq.
Massachusetts	Coastal wetlands	Ch. 130, Sec. 105
	Coastal and inland wetlands	Ch. 131, Sec. 40
Mississippi	Coastal wetlands	49–27–3 et seq.
New Hampshire	Coastal and inland wetlands	483–A:1–a
New Jersey	Coastal wetlands	13:9A–2
New York	Tidal wetlands Environmental Conservation Law	Sec. 25–0101 et seq.
North Carolina	Coastal wetlands	113–228 et seq.
Rhode Island	Coastal wetlands	2–1–13 et seq.
Virginia	Coastal wetlands	11–46.1–1
	Coastal wetlands	62.1–13 et seq.

A listing of State laws that include wetland regulatory components follows:

State	*Type of statute*	*Citation*
Alabama	Coastal area	Title 8, sec. 312–320
California	Coastal area	Pub. Res. Code 27000–27650
Delaware	Coastal zone	Title 7 Sec. 7001–7013
Florida	Comprehensive Critical Areas Act	380.05–380.055
Hawaii	Coastal shoreline setbacks	205–31 to 205–37
	Statewide zoning	205–2
Maine	Shorelands	Title 12, sec. 4811–4814
	Critical areas	Title 5, sec. 3310–3314
Maryland	Areas of critical State concern	Article 88C
Minnesota	Shorelands	105.485
	Comprehensive Critical Areas Act	116G.0. to 116G.14
New Jersey	Coastal areas	13.19–2
North Carolina	Coastal areas	113A–100 to 113A–129
	Areas of environmental concern	113A–114 to 113A–129
Oregon	Beach area	390.605 to 390.990
	Zoning	215.505
Rhode Island	Coastal areas	46–23–1
South Carolina	Coastal areas	(R204, S280 signed May 24, 1977)
Texas	Public coastal areas	5415–1
Virginia	Critical environmental areas	10–187 to 10–196
Washington	Shorelines	90.58.010 to 90.59.930
Wisconsin	Areas of critical or more than local concern	89–849 to 89–862

Local governments are claiming a larger role in determining the use and control of land and development within their jurisdictions. The implication of this trend for wetland protection under the shifting focus of police power within the States is significant. According to a recent study of State wetland programs undertaken by the Environmental Law Institute (ELI), the State-local relationship with respect to wetlands is changing in the direction of greater local involvement. After examining the State laws and discussing program administration with State and local officials, the ELI study [98] concluded that,

> "Despite some misgivings, state wetlands programs have moved toward increased local involvement. For example, the Massachusetts coastal program which originally placed primary permitting responsibility at the state level has shifted primary permit evaluation responsibility to local conservation commissions. Similarly, a recent task force appointed by the Governor of Rhode Island to review the state inland wetland law, strongly urged an increased local role. The Maine coastal wetland act and the New Hampshire inland wetland acts have also been amended to increase local responsibility. Basic enabling statutes in Virginia, Connecticut (inland wetlands) and New York (inland wetlands) place primary responsibility for wetland regulation at the local level."

Thus, while initial State actions with regard to wetlands came both because the wetland resource often spans two or more local jurisdictions, and because of the concern that local governments lacked resources and expertise to deal effectively with wetland problems, there appears to be a shift back toward local control. The trend toward a stronger local role in land use decisions is also reflected in general coastal management.

[98] Environmental Law Institute, op. cit. note 97, p. 59.

Marine Recreation

The Nationwide Outdoor Recreation Plan prepared by the Department of the Interior's Heritage Conservation and Recreation Service (formerly Bureau of Outdoor Recreation), which was released in 1974, concluded that water was the nucleus for

most outdoor recreation activities.[99] A similar conclusion was reached by the Stratton Commission in its investigation of ocean and coastal issues released in 1969: "Outdoor recreation is becoming a massive rush to the water," concluded its Panel on Marine Resources.[100] The most comprehensive evaluation of recreation to date, the Report of the Outdoor Recreation Resources Commission in 1962, reached the same conclusion.[101]

As a result, the most direct, personal public involvement with the coastal region for the general public is related to the quest for recreational experiences. The lure of the coast attracts massive numbers of people from the interior of the Nation as well as from the adjacent coastal States themselves. There are several indications that this is so:

- *Recreational Fishing*—In 1970, the Bureau of the Census found that about 9.5 million people over 12 years old went saltwater fishing three or more times per year and spent more than $7.50 per trip. Another study by the National Marine Fisheries Service, which included crabbing, clamming, and oystering, found nearly 11 million marine recreational fishermen in 13 northeastern States. The rate of increase in fishing participation was estimated at over 6 percent per year.[102] The Heritage Conservation and Recreation Service estimates participation in 1975 has grown to 207 million days of saltwater fishing, resulting in the expenditure of $3.4 billion.
- *Boating*—Recreational boating is a rapidly growing activity. The Coast Guard in 1976 estimated that there were 12.7 million recreational boats in the country; three-quarters were powerboats.[103]
- *Beach Recreation*—A broad cross-section of the general public uses coastal beaches as a recreational outlet. Millions visit the public beaches near urban areas, such as Jones Beach or Coney Island in the New York City metropolitan area, and the beaches of Southern California. More than 70 million visited Long Island public beaches nearly 10 years ago, and the number is even larger today.[104]

Overall park use in the Nation is on the increase, after a temporary setback during the fuel shortage of 1974. The National Park Service reported nearly 239 million visitors in 1975, up 7.5 percent from the previous year.[105] Similar increases were recorded in National Seashores and other marine-oriented facilities.

To the generally middle-income recreational activities of boating or offshore fishing, which are capital-intensive, must be added the recreational needs of the residents of the inner cities of the large coastal cities who are generally less mobile and less able to afford expensive recreational activities. Some of the needs of inner city residents are met by the parks and other public areas along the coast; however, additional needs of this urban group must be considered in the context of the inner city where the people live.[106]

Marine recreation is an economic stimulant. Second homes and commercial developments serving the recreational public generate tax revenues for States and local units of government. The tourist "industry" in general is enormous; according to the National Tourism Resources Review Commission, Americans spent $22.1 billion on travel and tourism in 1960–61 and $47.5 billion in 1970, and will spend an estimated $119.7 billion in 1980. Most of the activity takes place during the summer (36.5 percent), and the car was the means of transportation in 68½ percent of the cases.[107] A major part of the expenditures for travel and tourism was spent in the coastal region.

There are several major public policy issues involved in meeting the Nation's marine recreational needs: (1) provision for public access to coastal areas, (2) provision of recreational opportunities equitably among various sectors of society, and (3) problems of dedicating public areas for specific uses that restrict alternative use by others.

The Federal Government is limited in its ability to deal effectively with these problems. Much of the responsibility and legal authority lies with the States. The access-ownership question is intimately tied to State law and local customs. The equitable redistribution of recreational opportunities among the various sectors of society could involve major infu-

---

[99] U.S. Department of the Interior. *The Recreation Imperative: The Nationwide Outdoor Recreation Plan.* Published by the U.S. Congress, Senate, Committee on Interior and Insular Affairs, 93d Cong., 2d sess. Washington, D.C., Government Printing Office, 1974, p. 171.

[100] Panel Reports of the Commission on Marine Science, Engineering, and Resources. Volume 3, Marine Resources and Legal-Political Arrangements for Their Development, Panel VII, Report of the Panel on Marine Resources. Washington, D.C., Government Printing Office, 1969, pp. VII–235.

[101] U.S. Outdoor Recreation Resources Review Commission. *Outdoor Recreation in America.* Washington, D.C., Government Printing Office, 1962, p. 4.

[102] U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *Recreation—Marine Promise: National Conference on Marine Recreation.* Washington, D.C., 1975, p. 74.

[103] U.S. Coast Guard. *Nationwide Boating Survey.* Springfield, Va., National Technical Information Service, 1975.

[104] U.S. Army Corps of Engineers. *National Shoreline Study.* Washington, D.C., Government Printing Office, 1974, p. 182.

[105] U.S. Department of Commerce, Bureau of the Census, *Status* September 1976. Washington, D.C., Government Printing Office, 1976.

[106] New Jersey Department of Environmental Protection. *Statewide Comprehensive Outdoor Recreation Plan.* Trenton, N.J., 1973, p. 137.

[107] U.S. National Tourism Resources Review Commission. *Destination USA.* Washington, D.C., Government Printing Office, 1973, p. 1.

sions of public funds and a certain amount of societal dislocation. Conflicts among competing recreational interests is complicated by the virtual impossibility of reaching a consensus among divergent public and private interests, some of which are represented by powerful lobbying forces. There is conflict between recreational and preservation interests.

Meeting urban recreational needs in the coastal region is perhaps the greatest immediate problem and may also offer the greatest opportunity for innovation and success to the States, cities and Federal Government. Several cities have projects to revive older, often historic, waterfront facilities made obsolete by changing patterns of maritime transportation. In addition to attracting tourists and serving as residential and commercial centers, revitalized waterfront areas often included recreational opportunities for nearby residents. San Francisco, Boston, Newport, and Savannah are outstanding examples of waterfront restoration projects.

The growing demands for the recreational use of coastal lands and waters must be considered in the context of the finite extent of the coastal area, its development for private use, and the spiraling cost of land acquisition to preserve such land for use by the public. As an example: A stretch of beach less than 1,000 feet long in Boca Raton, Fla., recently commanded a price of $3.7 million. Land prices near major metropolitan areas are even more dramatic. The reservation of major portions of coastal land for public use is nearly impossible given the inflated coastal land values, the uncertain financial conditions of cities and States that find operating costs outdistancing tax revenues, and the limited amount of Federal funds available for land acquisition through the Land and Water Conservation Fund.

Public Access to the Coasts

Public access to beaches is a two-part problem: First, who retains rights to the use of beaches? Where does private property end and where do rights to public use begin? Second, if ownership of the beach margin is retained by the public, how does the public gain access to the shoreline across private property? These questions are complicated, because, under the American system of common law, each State is a separate sovereign and establishes its rules of law according to the historical customs and societal mores within that State. The evolution of State law from the Napoleonic Code in Louisiana, or Spanish land grants in Texas, can lead to significantly different rules of law than those of the States making up the 13 original English colonies. (See Appendix B.) Furthermore, each State has its own unique problems that tend to influence the evolution of law governing coastal use.

Four legal theories are cited as entitling members of the public to the use—as distinguished from ownership—of beaches: (1) *public trust doctrine,* (2) *theory of implied dedication.* (3) *customary rights doctrine,* and (4) *theory of prescriptive easements.* The last three theories are based upon the concepts of adverse possession and prescriptive rights and are grounded in the historical beneficial use of property by the public which in time ripens to a legal right, although that property may have been in private ownership originally. The trust doctrine, however, embodies the concept of sovereignty—residing in a governmental entity—which holds certain lands "in trust" for the public. Thus, the public interest in such lands is paramount to all private interests.

While these four legal theories form the basis for resolving the issues of public vis-a-vis private rights in beaches within several coastal States, their application is more the exception than the rule. Most States continue to recognize the right of property, whether for coastal beach access or use of the beach itself. Most States also permit local government to limit the use of beaches to individuals based on property ownership or residence within the jurisdiction of the local government.

The concepts of public use continue to change however. In 1976, the Georgia Court expanded public beach use in that State from the low-tide line to the high-tide mark.[108] Other complex legal questions continue to arise, such as whether the public beach area expands when new beach is formed over the old existing tide lines or do the private rights of adjoining property owners move seaward, pushing the public areas out to the newly defined high-tide line?

Oregon, Texas, and the Virgin Islands have enacted so-called "open beaches" laws in an effort to distinguish the public and private rights to beach use by statute.

The Texas statute was enacted in 1959 (Texas Ann. Stat., Sec. 5415(d), Vernon Supp., 1972). Sponsored by State representative (now U.S. Congressman) Robert C. Eckhardt, the Texas law seeks to: (1) preserve the public's rights to the use of State-owned and wet sand beach and so much of the dry sand beach as would be allowed under State common law; and (2) acquire a public right to use the dry sand beach based on a legal presumption of a reserved right of the public to use that area, notwithstanding a grant by the State to a private owner. The Texas model has been introduced by Congressman

[108] State of Georgia v. Ashmore et al., February 24, 1976, 236 GA. 401.

Eckhardt as a national legislative proposal in the 91st through 94th Congresses.

Oregon has enacted two statutes which deal with public use of beaches: (1) Oswald-West Act (1910) and (2) the "Beach Bill" in 1967 (ORS 390.600). The former, based on Roman law, declares all the State's wet sand beaches to be public highways. The latter declares it to be a matter of State policy to maintain the sovereignty of the State "heretofore legally existing over the ocean shore," so that the public can have the "free and uninterrupted use thereof." Control of the shoreline between mean low and mean high tide was vested in the State to preserve the public's right to use the beaches, and authority for the State to acquire access across private property for the benefit of the public was granted concurrently.

The Virgin Islands enacted the "Open Shorelines" statute in 1971 (12 V.I.C. 13). In addition to providing for beach use by the public, it created an Open Beaches Committee, which was authorized to make a comprehensive study of the Virgin Islands shoreline, including a survey of the public-private ownership boundaries, maps of public access routes, and a classification of beach uses. It defines the shoreline as the area between the low-tide line and either (1) 50 feet shoreward, or (2) the natural vegetation line "which spreads continually inland," or (3) a natural barrier—whichever of these distances was the least. Its constitutionality was upheld in the *Bolongo Beach Case* (VIDC No. 74–339, affd. 3d Cir., No. 75–1242 (1976)). The Virgin Islands statute does not provide for public access across private lands behind the defined shoreline.

Access to Public Beaches

Wherever the line of demarcation between private and public ownership (right to use) may be—mean high-tide line or mean low-tide line—the adjoining inland area is often private property. In many cases the public may have theoretical rights to beach use, but is often unable to gain access across the private dry sand beach. This is the case in California and Washington, for example.

In some states, traditional usage allows the public a *de facto* right to transit and use the dry sand beaches; private property owners have the legal right to exclude the public from these areas, but do not. This mode of customary usage exists in Florida and South Carolina.

Frequently, the general public may be excluded from entire reaches of municipal beaches, where private homeowners in a municipality resist the use of "their" public beaches by nonresidents. In New England many municipal beaches are either restricted to town residents or available only for a fee. Parking facilities are often limited or prohibited. As one journalist observed, "Any citizen can use the beach at East Hampton, Long Island, as long as he is willing to leave his car near Times Square and walk the rest of the way." [109]

While town beaches are under the control of a municipality, State and Federal facilities along the coast are open to the general public. The access problem for such areas may simply be lack of available parking. The Cape Cod National Seashore in Massachusetts, for instance, is plagued by this problem. The National Park Service limits parking availability as a means of controlling crowding, which may affect the dunes, vegetation, and other natural features.[110]

Public Beach Resources

According to surveys undertaken by the Outdoor Recreation Resources Review Commission in 1962 and the U.S. Army Corps of Engineers Shoreline Study in 1971, about 6 percent of the Nation's total shoreline is in public ownership. This figure is subject to considerable error, however, because sound data are not available on city and county coastal holdings identified on the basis of accessibility by fee or general admission; nor are data available for Federal installations with beachfront that might be accessible for limited recreational purposes.

The most thorough review of public beach resources was performed by George Washington University in 1962, in conjunction with the Recreation Review Commission (table 4–7). These data must be considered approximate, however.[111]

Since these data were collected, the public coastal recreation estate has increased, owing in large measure to the Land and Water Conservation Fund, which the Recreation Review Commission recommended in 1962. In particular, the Nation's authorized or existing National Lakeshores and Seashores have increased considerably since the early 1960s (table 4–8).

In an attempt to update the information on shorefront ownership and determine the amount of wet or dry sand beach in public/private ownership by States, a questionnaire was distributed to each of

[109] Calvin Trillin. "Some Reflections on Sand as Real Estate," *The New Yorker*, November 1972.

[110] U.S. Department of Transportation. *Recreation Access Study*. Washington, D.C., Government Printing Office, 1975, p. 139.

[111] George Washington University. *Shoreline Recreation Resource of the United States*. Washington, D.C., 1962, p. 12.

Table 4–7.—Statute miles of detailed shoreline, recreation shoreline, public recreation shoreline, and restricted shoreline, by major coastlines

Shoreline location	Detailed shoreline[1]	Recreation shoreline	Public recreation shoreline	Restricted shoreline[2]
Atlantic Ocean	28,377	9,961	336	263
Gulf of Mexico	17,437	4,319	121	134
Pacific Ocean	7,863	3,175	296	127
Great Lakes	5,480	4,269	456	57
U.S. total	59,157	21,724	1,209	581

[1] Compiled from data developed by the National Ocean Survey, National Oceanic and Atmospheric Administration. Excludes Alaska and Hawaii. The shoreline includes beaches, bluffs, and marshes.
[2] Military installations.

Table 4–8.—National seashores, lakeshores, and gateways [1]

Name and location	Date	Federal acres	Total acres
Apostle Islands National Lakeshore, WI.	9–26–70	27,093	42,216
Assateaque Island National Seashore, MD.-VA.	9–21–65	16,095	39,630
Canaveral National Seashore, FL.	1–3–75	41,024	57,627
Cape Cod National Seashore, MA.	8–7–61	25,744	44,600
Cape Hatteras National Seashore, NC.	8–17–37	30,325	30,326
Cape Lookout National Seashore, NC.	3–10–66	24,223	28,400
Cumberland Island National Seashore, GA.	10–23–72	15,631	36,876
Fire Island National Seashore, NJ.	10–9–65	5,945	19,356
Gateway National Recreation Area, NY.-NJ.	10–27–72	20,391	26,172
Golden Gate National Recreation Area, CA.	10–27–72	20,014	34,938
Gulf Islands National Seashore, FL.-MI.	1–8–71	75,806	142,062
Indiana Dunes National Lakeshore, IN.	11–5–66	4,476	12,534
Padre Island National Seashore, TX.	4–6–68	132,202	133,918
Pictured Rocks National Lakeshore, MI.	10–15–66	35,339	70,822
Point Reyes National Seashore, CA.	10–20–72	61,043	65,299
Sleeping Bear Dunes National Lakeshore, MI.	10–21–70	26,608	71,105

[1] Status as of June 30, 1977.

the State coastal zone management offices which received Federal matching funds to prepare shore access plans from NOAA's Office of Coastal Zone Management (Appendix C).

The responses to the questionnaire provide specific examples of the various types of problems associated with public use of beaches and shore.

The problem presented by the public having legal rights to the lower or wet portion of the beach while the upper or dry sand area remains in private hands is well illustrated in California.

Another major problem is demonstrated in both California and Florida where the land adjoining public coastal territory is in private hands. In Florida's case, nearly three-quarters of this land is privately held.

In Maine the questionnaire response points up one of the problems posed by customary State law. In that State, as well as in others, private ownership of the coast is permitted to the low-tide water mark. This effectively blocks public use of the shore if private owners are permitted to enforce their rights.

New Jersey is a case where control of the shore by municipalities is the dominant factor. Over one-half of that State's shore is owned by coastal cities and towns, which may or may not lead to preferential policies for local residents.

South Carolina is an illustration of a State where private holding of the coast is the rule. Over 100 miles of the State's coast is in private ownership as opposed to 65 miles in one form or another of public ownership.

The questionnaire response, while varying in degree of detail and partial in coverage, illustrates in specifics the range of problems discussed in this section.

Expanding the Public Beach Resource

There are three forms of legal interest in land that provide the right of access: (1) ownership—possession of title to the real estate, (2) easement—the right to enter, use, or pass across land owned by another without affecting the title of the owner; and (3) tenancy—leaser retains all of the rights of the

owner, based upon a contractual agreement. All three of these approaches have a role in providing additional coastal resources for public use.

Acquisition by Purchase

Purchase of coastal property in fee simple is the most direct and positive means of acquiring public beach and similar facilities. Federal aid in the form of matching grants to the States for purchase of recreational land, or transfer of excess Government land to the States, is available under several programs administered by Federal agencies.

The Land and Water Conservation Fund Act of 1965 provides the bulk of Federal funds available for purchases of recreational lands by the States and Federal agencies. The Fund has been expanded in recent years and now has a maximum authorization level of $900 million per year through 1989. The Fund, which is available for purchase of recreational land in any State, has been used extensively by the coastal States to acquire property in coastal counties (table 4–9). The information available provides no indication whether the funds expended in coastal counties were for shoreland or inland facilities.

States have used their Statewide recreation plans to emphasize a need for acquisition and development of coastal areas, as well as for providing access to the coast. The Florida plan has directed that State's efforts toward providing accessibility to water recreation areas, particularly coastal areas, for both extensive recreation use and preservation purposes with limited recreation use. South Carolina and New Jersey have had several large projects that enabled them to protect permanently extensive salt marshes and barrier beach fronts from development while affording a number of outdoor uses on these lands and waters. Connecticut has been able to acquire several outstanding beaches through the program. California has used significant amounts of the fund for both acquisition and development of facilities that have increased recreational use of the coastal zone. Washington has used a significant portion of the fund for both large acquisition projects as well as numerous small projects such as boat access and parking areas that provide access to coastal lands and waters. Texas has acquired several coastal areas including a 2,000-acre state park. On the Great Lakes, a number of boat access and parking areas have been acquired and developed, which has significantly increased access to those waters in the States of Michigan, New York, Pennsylvania, and Wisconsin.

Limits on the amount of State money available for matching Federal grants, however, reduce the practical effectiveness of the Land and Water Conservation Fund and other matching grant programs. Rhode Island has commented [112] that,

> "The State has considerable difficulty utilizing all [Heritage Conservation and Recreation Service] recreation funds within each disbursement year, even with local units of government and private donors contributing matching funds."

Similarly, New Hampshire reports an inability to acquire coastal lands for recreation because the State is unable to match the major assistance programs of the Department of the Interior. The States are finding it increasingly difficult to raise matching funds in order to participate in the numerous Federal progams requiring Federal-State cost sharing.

Table 4–9.—Total acquisitions by States in coastal counties compared with total Statewide acquisition from the Land and Water Conservation Fund [1]

State	Coastal county purchases	Statewide purchases	Percentage
Alaska	$ 4,013,575.00	$ 5,431,424.50	73
Oregon	3,237,536.60	14,569,812.77	22
Washington	7,987,953.46	12,541,425.73	64
California	48,651,484.23	64,092,765.87	76
Hawaii	7,417,963.95	7,956,322.95	93
American Samoa	67,650.00	67,650.00	100
Guam	15,000.00	79,000.00	19
Illinois	21,298,551.78	48,284,595.19	44
Indiana	360,234.85	8,114,770.27	4
Michigan	9,510,374.34	18,218,671.00	52
Minnesota	298,592.00	16,118,140.69	2
Ohio	12,177,162.56	29,045,565.50	42
Wisconsin	4,070,620.86	16,413,422.33	25
Alabama	333,079.12	3,020,289.45	11
Florida	23,858,009.45	29,327,216.00	81
Georgia	436,500.00	10,409,070.23	4
Mississippi	74,542.00	2,193,803.49	3
North Carolina	2,414,779.54	10,729,165.45	22
South Carolina	2,779,777.97	7,394,460.22	37
Puerto Rico	367,985.00	480,969.00	76
Virgin Islands	253,740.25	818,984.11	31
Connecticut	13,992,301.28	19,054,021.41	73
Delaware	9,454,260.88	9,554,260.88	98
Maine	3,362,578.47	6,783,782.02	49
Maryland	11,850,059.49	19,843,281.91	60
Massachusetts	4,703,339.47	15,078,365.02	31
New Hampshire	94,139.25	3,642,023.97	2
New Jersey	6,021,381.42	14,008,542.66	43
New York	10,925,448.98	17,280,443.50	63
Pennsylvania	850,759.97	7,644,322.85	11
Rhode Island	3,131,186.47	3,181,922.35	98
Virginia	6,741,546.26	21,106,484.17	32
Louisiana	7,783,450.21	12,236,407.79	63
Texas	6,837,268.55	17,096,254.97	40

[1] This analysis was prepared by the Office of Coastal Zone Management, NOAA, from data supplied by the Heritage Conservation and Recreation Service, Department of the Interior. Data are cumulative figures from the implementation of the fund through December 31, 1976.

[112] Letter from Daniel Varin, Chief, Department of Administration, Rhode Island, to Robert Knecht, Acting Associate Administrator, Office of Coastal Zone Management, NOAA, June 27, 1977.

A number of innovative approaches to raise funds for acquisition have been suggested. The Shoreline Protection Alliance of Honolulu has proposed a possible State-level solution, at least for States with large tourist businesses. In order to raise the funds needed to buy expensive coastal property in Hawaii, the alliance proposes a 4 percent hotel tax with the proceeds earmarked for beach purchases. Using the State outdoor recreation plan as its guide, the alliance estimates the Statewide need for additional public beach area at 1,200 acres by 1990, costing about $200 million. In contrast, the alliance reports, only $2.3 million was expended for beach acquisitions in a 2-year State capital budget of $470 million; likewise, the Honolulu City Council made available only $100,000 in 1976–77. The 4 percent hotel tax would raise $20 million per year and raise expenses for an average tourist by only 1 percent, the alliance notes.[113]

In addition to a straight purchase arrangement, there are several alternative access purchase options which can be used: (1) acquisition and lease-back, (2) acquisition and resale with restrictions on future use, and (3) acquisition by gift with possible restrictions.

Acquisition by Easement

Methods of acquiring public use of property short of outright purchase can include the following: (1) acquisition of an easement, which could include the right of the public to use property as an access way; (2) dedication of a piece of property to public usage in exchange for a tax reduction or similar benefit; (3) property trade, in which land of equivalent value would be exchanged for shorefront land needed for access purposes; and (4) dedication of property to public use as part of a subdivision approval.

Use of the subdivision ordinance authority by local governments, now widely practiced for school sites and parks, could readily be applied to the shore access question in undeveloped coastal areas. The same applies to local property taxes; these could be lowered to property owners permitting public use of their land in shore areas. State and Federal taxes might be examined for similar "breaks" that might be applied to property owners who grant the public certain prescribed uses of their land.

[113] Newletter of the American Shore and Beach Preservation Association, March 1977, p. 1.

Proposed Federal Beach Legislation

Between 1969 and 1975, Congressman Robert C. Eckhardt (D.-Tex.) has introduced bills in the Congress aimed at opening all ocean and Great Lakes beaches to the general public "for use as a common." [114] The Eckhardt proposal is based on the premise that the public has an inherent right to access to and enjoyment of the ocean. It seeks to realize this right of access by: (1) declaring that ocean beaches constitute a national resource and are therefore to be used by the public; (2) forbids barriers that restrict movement on or across beaches; (3) authorizes legal action in the name of the United States to impress beaches with a public usufruct; and (4) authorizes financial assistance to States for the acquisition of interests in beach and beach-related land.

While the proposal acknowledges the importance of private property rights that might conflict with the intent of the bill, every Federal agency with a jurisdictional interest objected to the proposal and recommended against enactment. Constitutional arguments were posted against the proposal by the Department of Justice, while Professor Charles W. Black of Yale Law School argued in support of the constitutional integrity of the bill in the only hearings held on the proposal by the House of Representatives in 1973.

There is little doubt that this legislative approach to clarifying the status of beach land would be the most direct way to bring uniformity and balance among the States in dealing with national shoreline problems. It could also possibly be the most inexpensive means for creating public access to beach resources. It would most assuredly, however, result in complex and extended litigation concerning the constitutionality and power of the Federal Government to intervene in what is considered by many to be the legitimate rights of States to regulate and administer property laws within their jurisdictions. The political path in the Congress would undoubtedly be difficult.

[114] H.R. 10394 (93d Cong., 1st sess.) is characteristic of the bills introduced by Congressman Eckhardt over the years. It would amend the National Estuarine Studies Act (16 U.S.C. 1221) by adding Title II thereto, and provide for administration by the Secretary of the Interior.

Federal Programs Supporting Marine Recreation

• *Land and Water Conservation Fund Act of 1965 [16 U.S.C. 460]*. This program is administered by the Secretary of the Interior, Heritage Conservation and Recreation Service (formerly the Bureau of Outdoor Recreation). It authorizes grants by the Secretary to States on a 50-50 matching basis: (1) for planning for outdoor recreation, (2) for the acquisition of land for outdoor recreation purposes, and

(3) for the development of outdoor recreation facilities. It also authorizes use of a portion of the fund by Federal agencies in acquiring land for recreation and conservation purposes.

Up to 60 percent of the Land and Water Conservation Fund (which had a total authorization of $900 million in fiscal year 1977) is available for grants to States (which include America Samoa, Guam, Puerto Rico, and the Virgin Islands); and States may pass all or part of the money on to local governments. In order to be eligible for a matching grant, a State must have:

- An approved Statewide comprehensive outdoor recreation plan (SCORP);
- Designated the State agency with whom the Secretary of the Interior is to deal;
- Evaluated the demand for, and supply of, outdoor recreation resources in the State;
- Established a program for the implementation of the Statewide plan;
- Provided such other information as the Secretary may request; and
- Provided opportunity for public participation in plan development.

Since the inception of the fund in 1965, through 1968, more than $3.5 billion has been appropriated by Congress. Of this amount, $1.886 billion has been earmarked for use by the States and local governments and $1.625 billion has been used by Federal agencies.

In addition, the lands and facilities to be acquired must be open to the general public. Development of basic—rather than elaborate—facilities is favored. Priority is given to projects serving urban populations. Grants are not available for operation and maintenance. The recipient State must dedicate the facility to outdoor recreation in perpetuity and be responsible for its operation and maintenance. Under certain conditions, State matching money may come from other Federal assistance programs, regional commissions, or donations.

With regard to the portion of the fund for Federal agencies (no less than 40 percent of the fund), Congress must approve any actual acquisition. The land acquired must be for use in some national program, i.e., national parks, seashores, lakeshores, forest, wild and scenic rivers, trails, historic areas, wildlife refuges, etc. A national recreation area is managed by either the National Park Service, the Fish and Wildlife Service, the Bureau of Land Management, or the U.S. Forest Service of the Department of Agriculture.

Revenues from the sale of oil and gas from the Outer Continental Shelf (OCS) now constitute part of the Land and Water Conservation Fund. In the seven years following the enactment of this provision in 1969, a total of $1.6 billion was dedicated to the Fund from OCS revenues.[115] Proposals have been made to enlarge the share of the OCS revenues that are dedicated to the Fund and to earmark them for acquisition of public shoreline and access in coastal States. This would be in addition to the amount of matching funds now available to coastal States from the fund.

- *Heritage Conservation and Recreation Service Organic Act [77 Stat. 49 (1936), 16 U.S.C. 1–3].* Under this law, the Heritage Conservation and Recreation Service provides two forms of technical assistance to Federal agencies, State and local governments, and private interests in relation to public recreation areas, facilities, and opportunities.

1) *Information Assistance.*—The Service maintains an Outdoor Recreation Information Clearinghouse that provides available information and data pertaining to the planning, developing, financing, and managing of outdoor recreation programs, and to research and educational activities relative to outdoor recreation. There is no land acquisition under this program, and the Service provides no financial assistance.

2) *Acquisitional Assistance.*—With this aspect of the technical assistance program, the Service works with State and local governments and private interests to obtain private contributions of land, money, or support for public outdoor recreation areas, facilities, and programs. Two methods are used, neither of which involves any stated eligibility requirements to be met by the recipient.

The first method is for the Service or a State or local government to locate a land resource with public recreational potential, and then for the Service to work with that government in developing an acquisition program that private contributors can afford. To the extent that financial assistance is obtained, the land acquired is purchased by the State or local government and operated and maintained by it as a public recreation facility. The Service does not acquire the land, nor does it contribute any money for its acquisition.

The second method is to identify any private interest already holding land with public recreational potential—including access to such lands—and attempt to persuade them to donate it to a State or local government for public recreational purposes. This donation can take the form of: (1) a gift in fee of the lands, (2) grant of a lease or easement, or (3) a management agreement between the donor and the State or local government in relation to the land. Again, the recipient State or local government is responsible for the operation and maintenance, not

[115] U.S. Congress. House of Representatives, Committee On Interior and Insular Affairs. Hearing To Amend the Land and Water Conservation Fund Act of 1965, and to Amend the Historic Preservation Act of 1966. Washington, D.C., Government Printing Office, 1975, p. 95.

the Service; and the Service provides no acquisition funding. During fiscal year 1976, 137,077 acres and 75 miles of trails, valued at over $25 million, were acquired pursuant to the acquisitional assistance method.

• *Federal Property and Administrative Service Act of 1949 [63 Stat. 385, 40 U.S.C. 484] in Conjunction With the Heritage Conservation and Recreation Service Surplus Property for Parks Program.* This statute is administered by the Administrator of the General Services Administration (GSA). The parks program is administered by the Service. The law authorizes GSA to dispose of surplus Federal real property to State or local governments at discounts of up to 100 percent. Disposal for public park and recreational purposes specifically is authorized. Under the program the Service actually handles conveyance of any such property to a State or local government.

After GSA has declared a parcel of Federal real property to be surplus, both GSA and the Service send a "Notice of Availability" of the property to appropriate State and local governments. Upon receipt of an acceptable application from the State or local government, the Service will convey it to the applicant. To be eligible, the applicant must, among other things, establish that the property is suitable for public park or recreation purposes and that, when developed, it will meet the recreational needs identified in its Statewide recreation plan. Any recipient is bound by the deed of conveyance to maintain the property in perpetuity for park or recreational purposes on pain of its reverting to the United States. The Service provides no funds for acquisition. Operation and maintenance of the property is the responsibility of the recipient government.

As of mid-July 1977, about 85,000 acres valued at $265 million had been transferred to State and local governments under the program.

• *Recreation and Public Purposes Act as Amended [44 Stat. 741 (1954), 43 U.S.C. 869].* This statute is administered by the Secretary of the Interior (Bureau of Land Management, BLM). The Secretary may dispose of specified amounts of public land by sale or lease to any State, any political subdivision of a State, or to any nonprofit corporation or association for public recreational purposes. A recipient must make prior application to the Secretary for such land, demonstrating in the application (to the satisfaction of the Secretary) that the land is to be used for "an established or definitely proposed project."

BLM holds little, if any, land in the original 13 States, Hawaii, Kentucky, Tennessee, Texas, and West Virginia. It holds most of its land in the western noncoastal and non-Great Lakes States (although it engages in some coastal recreational activity, e.g., in the King Range National Conservation Area in California). Hence, very little land has been made available to coastal States; the exact amount is unknown.

• *National Park Service Act, as amended [39 Stat. 435 (1916), 16 U.S.C. 1].* This statute is administered by the Secretary of the Interior (National Park Service, NPS). The Secretary may establish seashore or lakeshore areas as national recreational areas in the National Park System if the Congress authorizes the money for the purchase of the land in each individual instance. Historically, the areas acquired have been large and relatively undeveloped. They are open to the public, subject to certain restrictions on use.

The Park Service has designated ten national seashores and four national lakeshores. (See table 4–8). In addition, there are the Gateway and Golden Gate National Recreation Areas established in the New York and San Francisco metropolitan areas.

• *Sections 305(b) and 315(2) of the Coastal Zone Management Act of 1972 as Amended [86 Stat. 1280, 16 U.S.C. 1451].* This statute is administered by the Secretary of Commerce through NOAA's Office of Coastal Zone Management.

Section 305(b)(7) of the CZMA requires that a State's coastal zone management plan include, among other things:

> "A definition of the term 'beach' and a *planning process* for the protection of, and access to, public beaches . . ." (emphasis supplied)

Section 315(2) of the CZMA authorizes the Secretary to make grants to coastal States on a 50-50 matching basis for the purpose of "acquiring lands to provide for *access* to public beaches . . ." (emphasis supplied). No funding has been available to implement this provision.

• *Other General Purpose Statutes.* There are other Federal laws which, ancillary to their principal purposes, affect coastal access acquisition in varying degrees. Thus, under its Flood Insurance Program, the Department of Housing and Urban Development may purchase properties "damaged substantially beyond repair" by a flood disaster—including a hurricane—rather than pay the insured to reconstruct it, and then may sell, lease, or donate the property to a State or local government for at least 40 years for any use by that government, "consistent with sound management use." In this fashion, States and local governments could come into possession of coastal properties.

Under the River and Harbor Act [46 Stat. 945 (1960), 33 U.S.C. 426], the Corps of Engineers is authorized to help States and local governments control public coastal beach erosion through projects

not specifically authorized by the Congress. The Corps designs and constructs these projects up to $2 million or 50 percent of its cost for publicly owned shores (70 percent for public parks), whichever is less. This program assists in the reclamation of eroded public beaches.

The Federal-Aid Highway Act [90 Stat. 442, (1976) 23 U.S.C. 319] authorizes grants to States and local governments by the Department of Transportation for the purpose, among others, of providing roadside recreational areas, including access to these. To the extent that an ocean (or Great Lakes) highway was involved, this authority conceivably could be used for coastal beach area acquisition (highway-related recreational areas) and very probably beach-access acquisition.

Equitable Use: Private vs. Public Interest

The question of how to make coastal recreation opportunities available to all segments of the population is perhaps the most difficult policy question to deal with in marine recreation. Basic to the issue is the fundamental right of private property owners to enjoy the fruits of their labors. This increasingly has come to mean a piece of coastal real estate. Owners of such land naturally want to enjoy its use unimpaired.

The rapid expansion of the second home market along the coasts, the condominium construction boom, and the growth of trailer parks are all indicators of increased private use of the coast. This expansion of private use has two immediate and obvious effects: (1) prices are driven up as demand increases, and (2) the amount of territory left available for public purchase and use is increasingly smaller. On this latter point, the situation in Florida may be more desperate than other States, but it is representative: [116]

> "With the land use and development conditions prevailing in Florida today, the years immediately ahead may afford virtually the last opportunity to set aside and preserve land areas of exceptional natural quality for perpetual public enjoyment."

The private property owner's rights clash directly with the public's interest in having free and unfettered access to the coast. This is no different than the situation throughout the country, it is simply that coastal territory is extraordinary valuable for both private pursuits and public pleasures.

Hilton Head Island, South Carolina, puts the private vs. public coastal issue into perspective. The Sea Pines Plantation development there is a successful private venture noted for sound environmental principles and planning. The result is a resort with 1,300 homes and 1,154 "villas," in a well-designed and well-maintained luxury setting. For those who can afford the $100,000 lots and $225,000 houses, the setting is ideal. While not closed to the public, ($2 fees are charged), the island resort is essentially the playground of the very wealthy and the general public is effectively blocked from use of this portion of the coastal region. But to allow masses of people on a barrier island such as Hilton Head could mean that the carrying capacity of the island—its natural ability to absorb the impact of a large number of people and their cars—would be exceeded and the natural attributes of the island damaged.

The developer of Sea Pines, Charles Fraser, has discussed publicly some of the problems involved in allocating coastal territory—and some of the ironies involved. In a presentation at the first national coastal zone management conference, in June 1973, he said: [117]

> "I predict that when the National Park Service begins to propose plans for public use of Cumberland Island (Georgia), long sought as a national seashore area, there will be enormous pressures not to let many people use it. Let them go 'somewhere else'—where is the 'somewhere else?' At this moment in time, the safety valve for the pressures of the population desiring the seacoast vacation is, in fact, the uncontrolled, raw, boiling, and often ugly, privately-owned public beaches. At the public beach of Myrtle Beach (South Carolina), every inch of which is privately-owned (sic), there are today more people spending the night than are in our national parks. The National Park Service is only given funds by Congress to hire 13,000 year-round employees. Disney World alone employs more than that. . . . If we don't permit growth in response to economic demands, then we force the pricing mechanisms to say to many, 'You can't come,' or the most sophisticated reservation-makers to make their reservations two years in advance. If we let any jackass

[116] Florida Department of Natural Resources. *Outdoor Recreation in Florida.* Tallahassee, Fla., 1976, p. 9.

[117] Council of State Governments. *Proceedings of the Conference on Organizing and Managing the Coastal Zone.* Washington, D.C., 1973, p. 202

that wants to take a natural community of two-story houses, such as exist in many of our coastline areas, and which have water systems and sewer systems designed for low density, and let him come in with a blockbuster and put in a 25-story condominium that produces more cares, more sewage, and more water by a five-fold multiple than the entire community's prior development over a 40-year period, you create real problems. You do, indeed, however, help absorb the number of people who want to go to the coast."

The private sector plays an important role in meeting the recreational demands of the Nation. This demand fuels market forces that make coastal recreation an attractive, income-producing venture. By its nature, however, the private sector is disposed toward those with money to spend on leisure pursuits. The fundamental question is whether there is an acceptable balance between coastal lands retained for use by the general public, which may have limited surplus income to spend on recreation, and those areas in private ownership that are *de facto* dedicated to the use of the more affluent public. The proximity of recreational opportunities to the lower income public must be considered in determining whether such a balance exists.

A county-by-county inventory of total recreational resources (private and public) is required to provide an insight into this problem. Such information is not now available, but could be readily compiled by State recreation, planning, and coastal zone management agencies.

The increased demand for coastal space for private housing, which is further inflating prices in the coastal area, is driving out low- and middle-income families in some areas. California notes that few low- and moderate-income accommodations are being built in the coastal region. The reasons? Rising land prices, high construction costs, increasing property taxes, the relatively limited amount of land available, and the demand for higher cost facilities. "Many elderly and low-income people, for example, can no longer afford coastal living and are forced to live elsewhere," the California coastal plan concluded.[118] In addition, the California study found that rental units on the coast are being converted to condominiums, often forcing out elderly or moderate- and low-income residents unable to come up with the required down payments.

The California Coastal Plan recommends a number of policies to combat these trends, including use of the increased tax revenues from high-cost developments to provide facilities, such as campsites, for low- and moderate-income families.

Another aspect of the equity question is how well the needs of the urban poor are being met in terms of recreational opportunities. Congress, in increasing the size of the Land and Water Conservation Fund, directed that the Heritage Conservation and Recreation Service emphasize urban needs in the future. In response to this mandate, the Service surveyed urban recreational needs. A draft summary released recently concludes that virtually all of the metropolitan areas studied had serious problems in providing recreation; that neighborhood facilities were the most desired type of recreational outlet, rather than larger regional, State, or Federal installations; and that short travel times and access by foot, bicycle, or public transportation were necessary for day-to-day use to accommodate those without automobiles.

What the Service findings suggest is that "recreation" has to be redefined from traditional middle-class precepts in order to function successfully in a city setting. The New Jersey State Outdoor Recreation Plan makes the same point:[119]

> "The whim of the street is the personality of a city. . . Riverside Park in Manhattan is proof. [It]. . . is given character by the successive neighborhoods it flanks. The vista is. . . intriguing, yet it is easily topped in variety by the range of activities occurring —folk dancing, fishing, baseball, jogging, dog walking, sleeping, soccer, golf putting, sandboxes, sitting, sunbathing, car washing, car wrecking, picnicking, bike riding."

The success of Riverside Park is ascribed to: (1) its multiple use as a recreational facility—there is something for everyone, (2) convenience and accessibility, and (3) community pride wherein neighborhoods identify with individual segments of the park —a sense of belonging.[120]

A significant step in meeting the needs for urban recreation was taken by the National Park Service in establishing the Gateway Park complex in New York and the Golden Gate area in San Francisco. Although the Gateway Park has been criticized for being inaccessible to those without private transportation,[121] it has been praised by others for incorporating advanced transportation planning into recreational facilities.[122]

While recreational facilities that depend on the automobile present problems of access for the less mobile, most persons clearly prefer to travel by private automobile even when public transportation is available.[123] The Recreation Access Study commis-

---

[118] California Coastal Zone Conservation Commission. *California Coastal Plan.* Sacramento, Calif., 1975, p. 152.
[119] New Jersey, op. cit. note 106, p. 146.
[120] Ibid.
[121] U.S. Department of Commerce, NOAA, op. cit. note 102, p. 179.
[122] U.S. Department of Transportation, op. cit. note 110, p. 5.
[123] Ibid.

sioned by the Department of Transportation, and released in 1975, found that most recreational planning neither considers transportation access nor takes into account the needs of that part of the public which depends on public transportation.[124]

Transportation and recreation have become even more intimately entwined with the need for energy conservation and the goal of reducing air pollution caused by auto emissions. Boston's Revere Beach is one of the few examples of a coastal public beach facility that is adequately served by high-speed public travel on the rapid rail line.[125] However, few urban areas are blessed with high-quality beach facilities as close to the inner city as Boston.

The long-range effects of higher fuel costs on recreation need to be examined. There are already indications, some researchers report, of a trend toward fewer visitations, but of longer duration. Demand forecasts for marine recreation need to take into account expected higher transportation costs in the future as well as increased costs of operating boats.

[124] Ibid., p. 10.
[125] Ibid., p. 145.

Conflicting Uses

With increased demand for recreational space coupled with a dwindling acreage of suitable land available to serve the recreational public, pressures on the coast are mounting. Recreational activities are as diverse as the public itself. New forms of recreation are developing rapidly through the evolution of technology and innovation. Many of the new uses impose changing demands on coastal recreation facilities, and further complicate the conflicts between active and passive recreational pursuits. Dune buggies, dirt bikes, and hang-gliders were rarities on the beaches a number of years ago. Today, these offroad vehicles and airborne craft are claiming an equal right to beach access. Such activities conflict with a number of "traditional" coastal-oriented activities, e.g., bathing, hunting, bird and wildlife watching, and surf fishing.

The problem of resolving conflicts among competing uses is illustrated in the Gateway Natural Recreational Area in New York. The pressures here are magnified by the estimated 20 to 30 million visitors who will use the four segments of the gateway in the future. The four units of the Park have been historically used by nearby residents of Sandy Hook, N.J., and Staten Island, Jamaica Bay, and Breezy Point, N.Y. Local residents are only one interest group that the National Park Service must accommodate; they are the majority users and are not generally amenable to the recreational areas being made easily available to masses of "outsiders"—particularly inner-city residents.

Other segments of the tax-paying public bring counter pressures. Fishermen want to bring their surf vehicles to the shore; boaters demand expanded marina facilities and boat ramps; model airplane enthusiasts want space to pursue their hobby. Environmentalists, on the other hand, prefer that the areas be left in a natural state, even though the Park is on the doorstep of New York City.

The National Park Service (NPS) has agonized over the transportation problem in the face of similar opposing forces. Parking has been partially restricted, and bus service, rather than rail transportation, was chosen for commuters. A ferry service is also being considered.

The NPS has proposed building several "Gateway Villages," which would accommodate a variety of activities, including gardens and recreational facilities. The Sierra Club, on the other hand, is concerned that the centers will become "urban amusement and athletic centers." In fact, the Sierra Club sees the pressures on NPS to accommodate major active recreational functions as a key test of the National Park System. The Sierra Club anticipates that with State and local governments strapped for recreational funds, there will be increased pressure to fill the recreational void in national recreational areas. Environmentalists view areas like Gateway as the last chance to preserve some near-natural areas for the education and enjoyment of the urban resident.[126]

[126] Anon., "Gateway—the Promise and Problem of National Urban Recreational Areas," *Sierra Club Bulletin*, Summer of 1977, p. 33.

Role of the Private Sector

The private sector plays a major role in providing the public with recreational opportunities. Overall, private recreational lands (coastal and noncoastal) exceed the acreage of public recreational lands: 504 million acres in private ownership, and 491 million acres in public ownership.[127] The marine recreational industry, while difficult to assess, is estimated to have been a $5.5 billion activity in 1972 and is expected to grow to $12 billion by the year 2000.[128]

[127] U.S. Department of the Interior, op. cit. note 99, p. 95.

[128] U.S. Congress, Senate, Committee on Commerce. *The Economic Value of Ocean Resources to the United States*, by Nathan Associates. Washington, D.C., Government Printing Office, 1974.

There is an abstract quality about recreational experiences that defy mechanistic analyses. A trip to Malibu Beach, California, may be as much to see the houses of the famous as to use the public beach facilities. Or a trip to the Cape Cod National Seashore may involve visits to antique shops and country inns as much as wading in the surf. A trip to Atlantic City or Miami Beach may be prompted as much by the commercial attractions as by the quality of the public beach. Coastal recreation is often a multifaceted mixture of public and private activities interspersed with natural and secular experiences.

There are major industrial installations with recreational potential, such as powerplant sites, timber company lands, and petroleum company holdings.

In 1972, the Department of the Interior held a series of regional meetings on recreational issues, at which the relative roles of the private and public sector were discussed. The delineation between the government role and the role of private enterprise was found to be unclear. The participants reached the following conclusions:[129]

- Private enterprise should play the primary role where charges are to be made for facilities or services and there is a reasonable prospect for profit.
- Commercialized forms of recreation should be left to private enterprise, while government should provide the public with natural, historic, cultural, and archeological sites.
- Private enterprise should work closely with public agencies in planning and providing recreation facilities.
- Private operations should be kept free of undue competition from public operations.
- The public should recognize that investment by private enterprises reduces the need for public recreation investment.
- Private enterprise should act as a partner and constructive critic of government's recreational enterprises.

It is clear that the general public considers recreation to be a joint venture between public and private interests. Coastal recreation is not mutually exclusive. Recreational planning must optimize the mixture of private and public enterprise to best serve all sectors of the user public.

[129] U.S. Department of the Interior. *America Voices Its Recreation Concerns.* Washington, D.C., 1972, p. 36.

Ocean and Coastal Hazards

Introduction

Along with the fabulous resources of the coasts and oceans comes a distinctive set of natural coastal hazards that should be considered in public and private decisionmaking. The ten most important natural hazards (table 4–10) occur with some regularity. For example, in the document entitled, *Some Devastating North Atlantic Hurricanes of the 20th Century,* the National Oceanic and Atmospheric Administration tracks 54 selected hurricanes that hit the coastal areas of the Gulf and Atlantic coasts; in these storms 11,720 people lost their lives and billions of dollars of damage was done.[130] The list, of course, only includes a fraction of the total hurricanes that disrupt shipping and threaten the coast each year. An example of a less dramatic but still significant hazard is erosion, a major problem along one-quarter of the Nation's seacoast. Earthquakes are not only a major hazard along much of the Pacific coast, but also are a potentially devastating, although generally unrecognized, hazard to densely populated areas of the Atlantic coast. While these hazards vary in scope and intensity, all of them must be recognized, and plans for the management, mitigation, and recovery from the coastal hazards and their effects warrant a high priority.

Table 4–10.—Natural hazards of U.S. oceans and coasts

Hazard	Area affected	
	Ocean	Coast
1. Hurricanes and storm surges	X	X
2. Floods and flash floods		X
3. Tornadoes (water spouts) and severe storms	X	X
4. Earthquakes	X[1]	X
5. Tsunamis	X[1]	X
6. Coastal erosion		X
7. Land subsidence		X
8. Landslides	X[2]	X
9. Avalanches	X[2]	X
10. Volcanoes	X[3]	X

[1] Earthquakes and tsunamis are related. They affect ocean users primarily through tsunamis, the effects of which are primarily near shore where water shoals as it approaches the coast.

[2] Effects of landslides and avalanches on the ocean are the resultant localized tsunamis.

[3] Volcanoes can create new islands or undersea barriers for ships. Earthquakes sometimes occur with major volcanic action.

Although some steps have been taken by private parties, especially attempts to develop protective systems, the primary responsibility for developing policies and plans of action has fallen to Federal, State, and local governments. A high level of scientific expertise is required to develop an adequate understanding of what causes natural hazards, when they may occur, what forces are involved, what damage

or danger is likely, and what steps should be taken so that they do not become disasters. In addition, heavy investment in scientific equipment and other support systems is usually involved; therefore, the public turns to the government for programs to deal with these problems.

Natural Hazards

Many of the dangers to people and property that are created by natural hazards are similar even though caused by different natural forces or conditions, and many of the applied methods of management and mitigation are similar. The ten major coastal hazards and the particular types of danger and damage involved follow: [131]

Hurricanes are storms that develop in the tropics and attain windspeeds of 74 mph or greater, accompanied by dangerously high seas. The most destructive part of these storms is found within 50 to 75 miles of the center, yet lesser winds and seas can cover areas as large as 600 miles in diameter. Hurricanes can affect almost all of the U.S. coastline (including U.S. territories), except in the eastern Pacific where they have little impact north of Southern California.

The hurricane's storm surge and high seas are the greatest threats to life and property. They account for 90 percent of the fatalities and about 60 percent of the property that is destroyed or receives major damage. Storm surges are caused by air pressure differences between the hurricane and the rest of the atmosphere. However, the actual impact of the storm surge on a specific area depends upon many other factors (e.g., shape of the coastline, depth of the coastal water, speed of movement of the hurricane). The other dangers from a hurricane include high winds, heavy rains, and tornadoes. While hurricanes have average speeds of 10 to 15 mph in the tropics, they tend to move faster as they go further north. Some have reached forward speeds of 40 mph or more, leaving little time for the coastal population or mariners to prepare for them.

Coastal floods, or inundations of flood plains, usually affect larger areas in the South Atlantic and Gulf States than in the Great Lakes, New England, and Pacific States. Within the coastal area, the most vulnerable urban areas are along the Gulf coast, especially when they are near the mouths of rivers. The problem of flooding is aggravated along the Gulf coast by the fact that many of the urban areas have subsided. There are two major types of floods in coastal areas: localized flash floods may result when large amounts of rain fall in short periods of time, and coastal flooding may result from hurricanes. The flooding from hurricanes is of two kinds: flooding caused by the storm surge as seawater moves inland, and riverine flooding that occurs as rain runoff heads for the ocean. The major threats are loss of life, personal injury, property damage or loss, and ecological disturbance from freshwater or saltwater incursion.

Tornadoes are violently rotating columns of air that descend from thunderstorm cloud systems. With a path averaging an eighth of a mile wide and moving several miles at an average speed of 30 mph, tornadoes spread their destruction quickly, primarily through their high wind velocities, and then disappear back into the thunderstorms as quickly as they appeared. Although the highest incidence of tornadoes is in the Plains States, tornadoes are not inconsequential along coastal areas in Gulf and Atlantic coast States. To a lesser extent, the Great Lakes area also experiences tornadoes. Along the Gulf coast an added problem is large waterspouts that occasionally move inland as much as one-half mile. Tornadoes have been reported with hurricanes as they move ashore. In this case the tornadoes develop well away from the center of the hurricane and generally extend far inland in advance of the storm.

Earthquakes occur when the massive plates of the Earth's crust, which are slowly moving in opposition, release a portion of the accumulated pressure. The level of destruction accompanying an earthquake varies according to the magnitude and intensity of the movement of the Earth, with most earthquakes causing little damage but major earthquakes having the possibility of massive property destruction with thousands of fatalities. The amount of danger is also based on proximity to the epicenter of the earthquake, the type of soil involved, and the types of structures that exist in any particular spot.

Tsunamis, or seismic sea waves, are series of traveling waves of extremely long wavelength generated by underwater disturbances in the Earth's crust, usually earthquakes, but sometimes explosive volcanic eruptions. Localized tsunamis can also be generated by subaerial or submersive landslides. These waves are much longer from crest to crest than ordinary waves, and as coastal waters become more shallow, the waves may build to heights of more than 50 feet above the normal tide level and strike coastal areas thousands of miles from their epicenter. Damage is caused by flooding, rapid

---

[130] U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *Some Devastating North Atlantic Hurricanes of the 20th Century.* Revised 1977.

[131] Much of the material in this section on definitions is taken from: U.S. Department of Commerce, NOAA, Office of Coastal Zone Management. *Natural Hazard Management in Coastal Areas.* November 1976, pp. II–4 through II–74.

change in hydrostatic pressure, erosion, and collision with floating debris.

Coastal erosion seldom threatens lives, but the economic costs are high along the 2,700 miles where erosion is a critical problem (primarily along the Atlantic and Great Lake shorelines). Coastal erosion occurs when more shore zone material is removed than deposited.[132] It is a part of the natural shoreline process, but is a serious problem where development has occurred. As with all of the other hazards, the increase in potential hazard equates closely to the growing population in the coastal zone, especially since coastal land is demanding constantly higher prices. Erosion usually occurs through wind, water, gravity, or biological processes; ice may speed the process in the Great Lakes. Changing water level is the major long-term cause of erosion, but storms, with their attendant winds and waves, produce the most immediate and dramatic cases of erosion.

Land subsidence, the sinking of surface ground, is a second hazard where the primary threat of loss is economic, although there can be loss of life in the rare circumstances where subsidence leads to failures of dams or levees. Subsidence of coastal lands leads to potential loss of low-lying lands to submergence, and even if not submerged the threat of flooding is increased. Subsidence may also threaten a wide variety of construction and developments that have occurred on the affected property. The major causes of surface ground sinking in Alabama, California, Florida, Louisiana, Texas, and Washington are fluid withdrawals, hydrocompaction, and drainage of peat lands, while in Illinois, Michigan, New Jersey, New York, Ohio, and Pennsylvania the extraction of solids is an additional major problem.

Landslides are an endemic problem in the United States; however, the greatest level of danger in the coastal areas is in the Pacific States. A landslide is the "perceptible downslope movement of rock, debris, soil, or some combination of these materials."[133] Because landslide-prone areas are aesthetically pleasing sites and rapid population growth has led to the development of marginally stable lands, the problems of loss of property and life are steadily increasing despite the strictly localized character of landslides.

Avalanches are moving masses of ice and snow that accelerate as they flow down a mountainside until level or gently sloping land is reached. In the coastal zone, the only place where avalanches threaten is on the coast of Alaska. Because the population of Alaska tends to live in the narrow band of land between mountain and sea, the threat to property and life is relatively great, and it increases as the population mounts because of the necessity to use less advantageous areas for development. In an avalanche of any size, everything above ground level is swept away by the force of the moving materials. While both landslides and avalanches are caused by a variety of factors, they are especially related to earthquake activity, where they are major accessory phenomena.

Volcanoes are a hazard along the coast of Alaska and in Hawaii. Volcanoes are openings in the earth, usually on the top or sides of a mountain from which issue molten rock or gas. The danger derives from lava flows (molten material), pyroclastic flows (glass and rock fragments suspended in gas), volcanic mudflows (mixture of fine material and water), and ash falls (small fragments of rock temporarily suspended in air and deposited, according to size, by wind). Although the hazards from volcanoes are relatively localized and eruptions occur infrequently, the danger is ever present.

---

[132] Per Bruun. "Beach Erosion and Coastal Protection," in Rhodes W. Fairbridge (ed), *Encyclopedia of Geomorphology.* New York: Van Nostrand-Reinhold, 1968.

[133] U.S. Department of Commerce, NOAA, Office of Coastal Zone Management. *Natural Hazard Management.* Washington, D.C., p. II–37.

Elements of Natural Hazard Management

As is usually true in the delivery of important services to the public, many persons at all levels of government and in the private sphere are involved in the five elements of natural hazard management considered below:

Prediction and Warning

The activity most familiar to the general public, because of the activities of the National Weather Service (in the National Oceanic and Atmospheric Administration), involves the prediction of, and warning about, natural hazards. The type of prediction and warning required tends to divide along the lines of occurrences caused by atmospheric conditions and those caused by geologic conditions (although this is only a very general division and the overlap of factors cannot be dismissed).

The Weather Service has three hurricane forecasting centers, and the Department of Defense has one. These four centers are responsible for selected areas of the Pacific, Atlantic, Gulf of Mexico, and Caribbean Sea. Through the use of sophisticated procedures and equipment, these centers are able to track hurricanes and generally forecast their impact. This equipment includes a massive telecommunications network, satellites, reconnaissance aircraft, ocean data buoys, radars, and high-speed computers. Each center's forecasts and warnings are disseminated and

elaborated on by the numerous Weather Service coastal offices for hurricanes that affect the United States. The information provided to the public includes hurricane intensity, expected storm surge height, coastal area to be affected, rainfall potential, tornado potential, and suggested protective measures.

The amount of money spent on the hurricane warning system is an example of the cost of hazard activities. The basic budget for hurricane warnings in 1978 is $28,359,000, but this does not include any part of the cost for the regular forecasting or communication systems. Included in the budget figure are an environmental satellite system, the hurricane warning centers, hurricane research, and hurricane modification activities.

Along the coastal zone, flash floods are the major threat of flooding not connected to hurricanes. For flash floods, an arrangement of watches and warnings is used. These come from Weather Service offices and are based on a variety of factors such as the amount of rain, soil saturation, and amount of runoff because of development.

Tornadoes along Gulf coastal areas are primarily associated with developing storm systems and frequently start as waterspouts over the water which then move ashore. Tornadoes also are reported along the Great Lakes, although cold water suppresses development of such storms through most of the year. The Weather Service plays the major role in prediction and warning through the National Severe Storms Forecast Center, which issues the watches. Warnings are released by all Weather Service field stations. Watches and warnings are released through all available news media, especially radio and television. The coverage and release of these warnings vary considerably in effectiveness.

Earthquakes, tsunamis, landslides, avalanches, and volcanoes are primarily caused by geologic conditions. Short-term prediction, so that citizens can be warned to take protective action, is relatively crude for these types of disasters;[134] however, scientists hope for major progress in this area during the next decade. The U.S. Geological Survey (Interior Department) has an Earthquake Prediction Council that reviews data that could warn of an earthquake and issues predictions of earthquakes.[135] For the next several years, at least, the prediction of particular earthquakes will be primarily in a research and experimental phase.

Landslides and avalanches cannot usually be predicted on an individual basis. Gilbert White and Eugene Haas best describe the "state of the art" for both disasters when they note that: [136]

> "Although physical studies and experience have provided numerous clues, avalanche forecasting is still generally considered an art rather than a science. The variables that determine when conditions are ripe for the triggering of an avalanche are numerous and complex."

In all three cases, however, *it is possible to predict where the hazards exist.* For earthquakes the hazards can be delineated through general risk maps (which show the potential for damages based on the frequency of recorded seismic events), prediction of the distribution of strong ground motion of earthquake risk, and identity of ground conditions which lead to damage when shaking takes place. Locations susceptible to landsliding can be predicted—based on soil characteristics, geology, and related natural processes—but it is impossible to determine precisely the possible magnitude. Likewise, it is possible to predict the locations of possible avalanches by the signs of previous earth scouring and deforestation. The U.S. Geological Survey, National Academy of Sciences, and other groups are actively studying earthquakes and earthquake prediction. The U.S. Geological Survey has an active Landslide Reduction Program, and the U.S. Forest Service conducts research on avalanches on its land. All this information is now primarily of use in disaster preparation and long-term planning, not in short-term prediction of particular events.

The Pacific Tsunami Warning Center in Ewa Beach, Hawaii, has the capability of predicting the time of arrival of a tsunami, but it is not possible to predict the size, and this problem has led to overwarning and some loss of confidence. Information on seismic activities is sent to the Center via communication facilities of the Department of Defense, the Federal Aviation Administration, and other domestic and foreign agencies. When an earthquake of large magnitude occurs in an area of the Pacific that favors the generation of a tsunami, the Pacific Tsunami Warning Center forecasts the time of arrival of the tsunami at selected points. A tsunami watch begins as soon as positive evidence of a tsunami exists; warning bulletins are released with observed wave magnitudes described and other pertinent information included. These bulletins are sent to civil authorities in the five Pacific States, to various civil and military organizations, and watch and warning information is supplied to a number of foreign governments. The necessary actions needed

[134] U.S. Congress, Senate Committee on Commerce, Hearings on the Earthquake Disaster Mitigation Act of 1975, S. 1174. 94th Congress, 2nd sess., 1976. pp. 87–90.

[135] U.S. Executive Office of the President, Office of Science and Technology Policy, Earthquake Hazards Reduction: Issues for an Implementation Plan (draft), pp. 25–32.

[136] Gilbert F. White and J. Eugene Hans, *Assessment of Research on Natural Hazards.* Cambridge, Mass., MIT Press, 1975, p. 354.

to protect the public and minimize damage depend upon State and local authorities.

The prediction of volcanic eruptions on Hawaii has been relatively successful. The Hawaiian Volcano Observatory (U.S. Geological Survey) has a working warning system and the less-violent types of eruptions that occur there allow adequate time for evacuation when necessary. Predictive capabilities for the Cascades and Alaskan volcanoes are minimal, nor has the warning system on the continental United States been tested for this type of crisis. The U.S. Geological Survey is planning a system of surveillance of the inactive volcanoes of the Pacific Northwest using infrared sensing, and the 12 existing volcanoes will be monitored intermittently by instruments.[137]

Subsidence has, on occasion, caused failures of levees or dams; however, the largest number of cases are gradual and the direct hazard is economic loss rather than the loss of life. Because the problem is usually caused by man's removal of liquid or solid materials from the earth's crust, the ability to predict where the problem might occur exists through the examination of these activities and relating them to soil and subsoil conditions. The U.S. Geological Survey and the Bureau of Reclamation have looked into subsidence; however, little effort has been expended in this direction to date. Gilbert White, et al.,[138] note that few subsidence studies have been done at the Federal level.

> "At present, no national policy deals with land subsidence. However, because of the widespread nature of this hazard, such a policy may be needed. Justification for a subsidence warning program lies in the Disaster Relief Act of 1974, which declares the need for disaster warning with respect to geological catastrophes."

The prediction of erosion creates a peculiar set of problems. White and Haas argue that warnings against imminent erosion should be made only when unrelated to wind or flood hazards. Even then, there is little that can be done, on short notice, to prevent erosion. Given the cost and difficulty of emergency measures and the relatively small number of structures affected at any one time, it is probably desirable to focus activity on forecasting long-term erosion possibilities.[139] Then appropriate planning and mitigation programs can attack the problem.

Once again, the primary types of predictions and warnings are long-range forecasts in the form of risk maps that generally depict average rates of historical shoreline change as determined from earlier maps, charts, surveys, aerial photographs, and similar sources. The Federal Insurance Administration, Natural Ocean Survey-Coastal Mapping Division, and the Corps of Engineers all have an interest in this area and either produce Storm Evaluation Maps or other types of information such as Flood Plain Information Reports. Joe Moseley and Sally Davenport point out that much of the information produced does not reach the hands of citizens buying the land; for example, developers in Texas have not made the information available and have opposed State laws requiring disclosure of natural hazards.[140] The final effect of hazard mapping and similar work depends on the cooperation of, and its use by, the States and local governments in the various transactions and decisions involving erosion-threatened areas. It is up to these governments as to how they involve developers, buyers, and other interested parties in the decision-making process.

Prediction and warning systems are essential in minimizing losses due to catastrophic events (those in which damages to property, human health, and social structure or processes are of such severity that recovery and rehabilitation is a long and trying process). Obviously, both the ability to predict the occurrence of such hazards and to warn the public of the impending dangers are important; research is necessary in the area of citizen reaction to warnings, because many people do not adequately respond to the warnings that they receive.[141,142]

Research has also shown that prediction warnings are just the first step in the chain that includes dissemination and response. To ensure appropriate response, local authorities must develop local plans to change warnings into specific actions.[143,144] The plans are ultimately no better than the reactions that they generate among the public. The only way natural hazard management systems will work is if people understand the hazards and the plans and

---

137 U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *A Federal Plan for Natural Disaster Warning and Preparedness.* Washington, D.C., June 1973, p. 53.

138 U.S. Department of Commerce, NOAA, Office of Coastal Zone Management. op. cit. note 133, p. II–73.

139 Gilbert F. White and J. Eugene Haas, op. cit. note 136, p. 360.

140 Joe C. Moseley, II, and Sally S. Davenport, "Hurricane Damage Reduction and Coastal Management," paper presented at Coastal Zone '78, conference sponsored by Conservation Foundation, American Society of Civil Engineers, and U.S. Department of Commerce, NOAA, Office of Coastal Zone Management, March 14–16, 1978, p. 16.

141 U.S. Executive Office of the President. op. cit. note 135, Hazard Reduction, pp. 8–9.

142 Gilbert F. White. *Flood Hazard in the United States: A Research Assessment.* Boulder, Colo., University of Colorado, Institute of Behavior Science, 1975, pp. 83–85.

143 Benjamin F. McLuckie. *The Warning System in Disaster Situations: A Selective Analysis.* Research Report No. 9 Columbus, Ohio: The Ohio State University Disaster Research Center, 1970.

144 Dennis S. Mileti. *Natural Hazards Warning Systems in the United States.* Boulder, Colo., University of Colorado, Institute of Behavior Science, 1975.

believe in the necessity of following these plans. Unless citizens react to a warning and evacuate the seafront when a hurricane threatens, the plans will accomplish little (except lull those responsible for the plan into thinking that everything is all right). Paul J. Hebert and Glenn Taylor, in their study of hurricane experience levels on the Gulf and Atlantic coasts, point out that:[145]

> "Combined population increases since the last major hurricane for each area indicate that over 28 million people along the Gulf and Atlantic coasts have never experienced a direct hit by a major hurricane. This is over 75 percent of the Gulf and Atlantic coastal residents of the United States. Six states have not had a single direct hit by a major hurricane in this century, while almost 80 percent of the coastal population of Florida—the most hurricane-prone state—have a low hurricane experience level.
> "The *main point* to be made here . . . is that *most of the people* who go through hurricanes experience either a relatively weak hurricane (categories 1 and 2), or an indirect hit (fringe conditions) by a major hurricane. Generally less than 25 percent have actually felt the most intense central core region of a major hurricane. This breeds potential disaster by creating a sense of false security for 75 percent or more of the "experienced" coastal residents during the next major hurricane situation."

Plans must be carefully examined to see that they are understandable and maintainable on the basis of new data and situations. Officials have an obligation to formulate plans that will be found reasonable and to adjust those plans in response to citizen reaction.

A second type of prediction is just as important, if not as dramatic; that is, the type of prediction that shows the long-range possibility of hazard, the type of hazard, and the magnitude of the danger. It is through this type of prediction that successful natural hazard management can take place. It requires historical information, trend studies, hazard mapping, development plans for the areas, and a wide variety of other information. While much is being done in this area, numerous tasks are incomplete or not even started.

Land Use Management

The potential importance of land use management and regulation in hazard areas is pointed out by Earl J. Baker and Joe Gordon McPhee who say that: [146]

> "A recurrent theme in dealing with all of the natural hazards is the potential of land-use management to promote socially desirable use of vulnerable areas in the United States. The rapid encroachment in the hurricane zone of the South Atlantic coast, the progressive invasion of industrialized flood plains, the design of mobile home parks without shelters against tornadoes, and the continued building upon landfill in areas of high seismic risk illustrate the land-use changes which are occurring and which call out for sober consideration of risk involved.
> "For each of the geographical hazards it is apparent that attention should be given to ways in which land use planning may contribute to effective use of the soil and water resources, candidly examining the hard political considerations that shape what a community finally does about exposing itself to risk. In each case a needed study of land-use problems is closely linked with associated questions of control and protective work, warning and emergency action, insurance and relief and rehabilitation."

Land management can be a key to all of the various parts of natural hazard management because, through zoning and control of land use, major decisions are influenced as to how densely populated hazardous areas will be and what types of development and activities will be allowed. These factors then prescribe the type of protective structures that are economically feasible, the kinds of needed evacuation plans, the kind of warning system, and the time when the warning must be received (based on escape routes, danger of those routes being closed, number of people who must use them, etc.), the kinds of damage that will be done and the number of lives that will be endangered, the costs of insurance and repair, and the length of rehabilitation for the community (so that it can function as a socioeconomic system). It is the control and mitigation of these types of problems that forms the basis for all programs of natural hazard management and mitigation.

Local governments usually have the primary responsibility for land-use management. Among the

[145] U.S. Department of Commerce, NOAA, National Weather Service. *Hurricane Experience Levels of Coastal County Populations—Texas to Maine*, Washington, D.C., July 1975, p. 9.

[146] Earl J. Baker and Joe Gordon McPhee. *Land Use Management and Regulation in Hazardous Areas: A Research Assessment*. Boulder, Colo., University of Colorado, Institute of Behavioral Science, 1975, p. XI. Much of the following material on land use management comes from this monograph.

powers that local governments can use are zoning ordinances (specifying types of land use, density, and other factors), subdivision regulations, Planned Unit Development regulations (combining high-density/intensity uses with open space), setback lines, building and housing codes, taxation, location of key facilities (water and sewer lines, schools, and hospitals) drainage and sanitary codes, public acquisition and development, scenic easement, permits for special use, and similar devices. The use of these powers to develop a rational land-use policy in hazard-prone areas can be encouraged by both State and Federal Government.

Many of the same powers exist, although in a more generalized form, at the State level. For instance, 41 States have authorized local governments to implement flood plain zoning. The State of Wisconsin "explicitly requires local flood plain zoning, and provides for state-imposed zoning should local entities fail to enact their own."[147] Some other States, such as Hawaii and Maine, have Statewide zoning. Wetlands often are protected by State laws, as are dunes, beaches, and other natural protective barriers. And, of course, any State can require a specific level of detail in local efforts at land-use management.

The Federal Government has become involved in land-use management in its own lands and is attempting to have an increasing, although indirect, influence on land-use management through several laws and programs dealing with the coastal zone, hazard insurance, and resource management. The Coastal Zone Management Act as amended (P.L. 94–370) requires coordination of Federal activities in the coastal zone and makes funds available to aid States in coastal planning. The Office of Coastal Zone Management has made an initial step in hazard planning through an agreement with the Texas General Land Office, which is developing the coastal zone program, to spell out considerations of hazard management to be included in the State program.

The various acts on flood insurance and disaster relief that have been passed during the last decade all require, as a prerequisite of Federal benefits or aid, that land-use controls be established that consider the particular hazards being insured against (National Flood Insurance Act of 1968 [P.L. 92–213], the Flood Disaster Act of 1974 [P.L. 93–288]). Developers of land sold in interstate commerce are now required to disclose hazards to which that land is subject by the Interstate Land Sales Full Disclosure Act of 1968 (P.L. 90–448). The requirement for an environmental impact statement to be filed with each major Federal action compels Federal agencies to examine the impact of their activities on the land use patterns of the communities being aided or affected. Section 73 of the Water Resources Development Act of 1974 (P.L. 93–251) authorizes Federal agencies to consider the use of nonstructural measures (such as purchase of flood plains, relocation or flood proofing of structures, and flood plain regulation) to control damage due to floods. The section also limits non-Federal participation in recommended measures to 20 percent of project costs. Full implementation of this provision has been deferred pending review of Federal policy on cost sharing for water resource development and clarification of the appropriate Federal role for implementing nonstructural measures.

While land-use management is a potentially useful tool in natural hazard management, there are practical limitations that keep it from achieving its full potential. Private landowners and developers consider any limitations upon their ability to use land as a limitation of their property rights and their right to a profit. Since developers are one of the major interest groups influencing local government decisions, land-use planners have limited ability to make totally objective decisions about the use of hazardous lands. A less threatening, but still controversial, aspect of planning is the promulgation of proper building codes so that structures will withstand hurricane winds, erosion, and storm surge if in a hurricane hazard area, or that a building is "flood proof" when in a flood plain. For example, Joe Moseley and Sally Davenport report that a building code which uses a 140-mph wind design standard (table 4-11) adds no more than 2 to 3 percent to the finished cost

Table 4–11.—Estimated cost increases and damage reductions when building in compliance with hurricane resistant building codes [1]

Cost increases and damage reduction per:	Storms of specified intensity		
	Minimum (60 mph)	SSBC (105 mph)	Tx. Model (140 mph)
	percent	*percent*	*percent*
Cost increase by type of structure:			
1,500 sq. ft., brick	—	0–1	2
1,500 sq. ft., frame	—	0–3	1–3
3,000 sq. ft., brick	—	0–2	0.5–3
3-floor condo	—	0–2	0 3
10-floor condo	—	0–2	0 2.5
Damage reduction:			
Loss per $100 evaluation	4.89	2.74	2.14
Loss reduction		44	56

[1] Source: Charles Hix. *Estimated Increased Building Cost Resulting From Use of Hurricane Resistant Building Code.* College Station, Tex., Texas A&M University, 1975. And: William G. Lesso. *Potential Wind Damage Reduction Through Use of Wind-Resistant Building Standards.* Austin, Tex., Texas Coastal and Marine Council, 1976. Combined by Joe C. Moseley, II, and Sally S. Davenport in "Hurricane Damage Reduction and Coastal Management," (text footnote 140) p. 15.

[147] Earl J. Baker and Joe Gordon McPhee, op. cit. note 146, p. 82.

of a typical building and, at the same time, reduces potential windstorm damage by 45 to 55 percent.[148]

Although building codes are usually enacted at the local level, the Federal Government is influencing policy in this area. The National Flood Insurance Administration offers insurance to communities that agree to require structures to be elevated or flood-proofed to the level of the 1 percent probability of flooding. The Flood Disaster Protection Act of 1973 prohibits the use of Federal funds for construction in, or acquisition of, flood-prone land. The Disaster Relief Act provides sanctions against communities not insuring public structures. The Corps of Engineers produced a technical report in 1972 entitled, *Flood Proofing Regulations,* that lists a variety of flood-proofing measures. The National Bureau of Standards also has a report on *Building Practices for Disaster Mitigation.*

A second aspect of the building code problem is dealt with by the *Mobile Home Construction and Safety Standards Act* of 1974 (P.L. 93–383), which "establishes structural design requirements that must be met in order for mobile homes to obtain designation as 'Hurricane Resistive.' " [149] This Federal law is reinforced in many States by "tie-down" legislation which requires mobile homes to be anchored to their foundations so that they can withstand certain wind loads and avoid being easily overturned or moved. The Council of State Governments included a mobile home tie-down model act in its Suggested State Legislation for 1975.

Finally, the foundation for successful land use management is based upon a full knowledge of the hazards that may occur and their consequences. Several Federal Government agencies, in cooperation with all levels of government, are mapping hazardous areas through a variety of techniques. NOAA and USGS have ongoing programs to map areas susceptible to earthquakes, tsunamis, landslides, and volcanoes. As mentioned above, NOAA is also engaged in mapping hurricane storm surge areas along the Gulf and Atlantic coasts. The Corps of Engineers, HUD, and the Soil Conservation Service have been mapping flood hazards for several years in virtually all areas of the United States.[150] A concentrated effort to bring all of this information together and make it available to local disaster planners, private developers, and land-use managers should be a focus of Federal programs charged with helping State and local authorities in hazard management.

[148] Joe C. Moseley, II, and Sally S. Davenport, op. cit. note 140, p. 15.

[149] U. S. Department of Commerce, NOAA, Office of Coastal Zone Management, op. cit. note 133, p. II–37.

[150] Earl J. Baker and Joe Gordon McPhee, op. cit. note 146, p. 22.

[151] Joe C. Moseley, II, and Sally S. Davenport, op. cit. note 140, p. 12.

Disaster Preparedness Plans

The third major facet of natural hazard management is preparation to cope with a hazard when it is no longer just a possibility, but is a threatening reality; this is the development of a disaster preparedness plan. Disaster preparedness planning is primarily left up to State and local governments. As of the beginning of 1978, 22 States have passed legislation based on the Council of State Governments' 1972 Model Disaster Act, which gives the governor primary responsibility for disaster preparedness.[151] Although disaster preparedness plans vary somewhat in their contents, the planning programs generally include the following:

1. Vulnerability analysis—"a systematic investigation of potential disasters in terms of probability, frequency, magnitude, and location in order to forecast their probable effects, in specific geographic areas, on the people, systems, facilities, resources, and institutions." [152]
2. Establishment of building and land-use codes based on vulnerability analysis, and monitoring of codes for compliance.
3. Maps showing areas of natural hazards and types of hazards.
4. Warning, evacuation, and rescue plans—describing types and levels of warning and response expected for each; routes to follow for evacuation; shelters for displaced people; emergency communication/coordination centers and systems; essential resource maintenance and distribution (food, water, medical supplies); protection for evacuated property (from looting, vandalism); procedures for returning to evacuated areas; and other necessary activities.
5. Cleanup, repair, and rehabilitation plans—including factors such as systems for obtaining State and Federal aid; application of building and land-use codes during rebuilding; and similar activities.
6. Public information and education.
7. Plan implementation tasks—including resource identification, responsibility allocation, and coordination of preparation.
8. Plan maintenance—including plan updating and improvement, and staff training.[153]

Although State and local governments have the predominant role in this area, several Federal agencies are active in encouraging and helping the States with these activities. The National Ocean Survey/ Coastal Mapping Division is carrying out a long-term program of preparing storm evacuation maps

[152] U.S. Department of Housing and Urban Development. *Federal Register,* May 28, 1975, p. 23268, section 2205.76.

[153] In part, taken from: U.S. Department of Commerce, NOAA, National Weather Service Disaster Preparedness Staff. *Guide for Flood and Flash Flood Preparedness Planning.* Washington, D.C., May 1977.

indicating elevations and available evacuation routes from vulnerable coastal areas. These maps feature high-resolution relief so that local disaster officials can choose the most suitable evacuation routes to safety inland. National Ocean Survey has produced over 60 of these maps to date; about 12 maps per year are planned for the rest of the program, which will end in 1986 with about 175 maps published. The U.S. Geological Survey maps flood-prone areas and documents major floods; the National Weather Service compiles relevant statistics on all weather-related disasters and makes the information available; the U.S. Department of Agriculture provides technical aid in rural areas; the Corps of Engineers, HUD, National Science Foundation, and the Office of Water Research and Technology are all involved in flood-related research that is available to local officials. In dealing with tornado disaster plans, the States may call on the help of the Weather Service's Disaster Preparedness Program, the Defense Civil Preparedness Agency, the Federal Disaster Assistance Administration, and the Department of Agriculture's Extension Service. As an example, the May 1977 Disaster Preparedness Report of the Weather Service notes that statewide mandatory tornado drills in schools are in effect in nine States and that nine other States are working on plans to do the same.

The aim of Weather Service's Disaster Preparedness Program is to increase the number of well-prepared communities (for all types of weather-related disasters) in the United States. The Federal Disaster Assistance Administration administers the Federal program designed to encourage "the development of comprehensive plans and practicable programs for preparation against disasters, including hazard reduction, avoidance, and mitigation and for providing guidance to state and local governments in coping with pending or actual disasters." [154] The Disaster Relief Act of 1974 made available funds (100 percent Federal up to $250,000 per State) for developing State disaster plans and an annual matching grant of $25,000 for improving, maintaining, and updating the State plan; however, State plans are generally geared toward reaction to hazards rather than preparation to mitigate their effect. No Federal money was provided for local plans, and the success of reaction to disaster depends on local preparedness. Natural hazards should play a larger role in planning, local governments should be encouraged to have adequate disaster plans, and those plans should include mitigation features as well as emergency action and recovery segments.

[154] U.S. Department of Housing and Urban Development. *Federal Disaster Assistance Administration Program Guide.* Washington, D.C., September 1976, pp. 11–12.

Hazard Mitigation

The fourth aspect of a management system attempts to limit the destructive capabilities of the hazards by developing protective structures, by assisting and strengthening the natural protective systems, and by instituting land-use and building codes.

Structural protection is best suited to flooding, erosion, and certain types of protection from waves and storm surge in hurricanes. Structural protection is not exceedingly useful against tornadoes, landslides, avalanches, tsunami waters, and volcanoes, although some benefit can be derived in all of these areas. With the problem of subsidence, the only useful role than can be played by structural protection is that of holding surface waters off sunken land. This becomes a monumental task, and probably an impossible problem, when combined with the pressures of storm surge and waves from a hurricane. These structures often have unanticipated consequences ecologically, either in the immediate area or in surrounding areas.

Sand dunes, beaches, barrier islands, mangrove stands, wetlands, and similar natural features often serve as protection from hurricane surge and wave action. In some places dunes have been built artificially; in other places dune stabilization is aided by means of vegetative plantings. Where appropriate, fixed or mobile sand bypassing systems are used to maintain the normal movement of sand because of currents and other natural forces. The Corps of Engineers and NOAA are both involved in research concerned with maximizing the possibilities of natural protective devices and features in the coastal zone.

Beach nourishment is practiced in many locations. Sand or other materials from another source is trucked in, or sand from the sea or lake bed is dredged and placed on a beach that is eroding and dwindling in size, because it has been denied a natural source of the appropriate material. Although this method is relatively successful in curtailing erosion to at least a minimum level, and is aesthetically pleasing to many people, it offers only a temporary cure for the symptoms of erosion and does little, if anything, to correct the causes of the problem.

Another way of seeking protection from natural hazards is to modify the occurrence of the hazard be decreasing its force, or destructive power. This involves an attempt to influence the basic physical forces controlling the natural phenomena. This, of course, requires a great deal of research in, and understanding of, these phenomena; this type of research is an ongoing part of agencies such as NOAA, the U.S. Geological Survey, and NASA. A major area of interest is the possibility of modifying weather conditions such as fog, hail, hurricanes, and lightning. For example, it is possible to disperse fog

at airports. Other types of weather modification have been less successful and more controversial. Although there has been little activity during the last 10 years, major attempts at hurricane modification will be carried out in the next few years.

At the other end of the spectrum, there have been suggestions that the danger of major earthquakes might be lessened along the San Andreas fault in California by setting off "controlled" quakes to release the tension where it has not been accomplished through the occurrence of numerous small tremors. However, earthquake control appears to be beyond the knowledge and technical capabilities currently available. While modification of natural hazards may not be a major factor in the immediate future, the study of such possibilities will continue, and the benefits accruing from such studies will continue to be available even if they do not accomplish their ultimate goal.

Recent progress in understanding the mechanisms of earthquakes and identifying potential warning signs offer some hope of being able to predict earthquakes from a few days to a few months before they occur. Routine operational predictions of large earthquakes are still a decade or more away; nonetheless, predictions could give communities an additional earthquake hazard reduction tool for taking such mitigative actions as identifying and strengthening weak structures.

Disaster Relief and Rehabilitation

The fifth part of natural hazard management deals with the result of a natural disaster through relief and rehabilitation. Prediction and preparation influence the relief and rehabilitation phase, because they help to determine how serious a catastrophe may be. Once a hazard has occurred, it is necessary to offer relief (meeting of immediate needs) and rehabilitation (helping the community regain its capacity to work as a socioeconomic system) as quickly and efficiently as possible.

When a major disaster strikes and the necessary relief exceeds the resources of a State, a governor may ask the President to declare a "major disaster" or an "emergency." The declaration, in turn, triggers Federal disaster relief programs which are coordinated by the Federal Disaster Assistance Administration (FDAA) within the Department of Housing and Urban Development. As spelled out in the *Federal Disaster Assistance Administration Program Guide:*[155]

> "After the President's declaration of a major disaster, the Governor of an affected State and the appropriate FDAA Regional Director execute a Federal-State Agreement which prescribes the manner in which Federal aid under the Disaster Relief Act of 1974 is to be made available. The Agreement lists the areas within the state eligible for assistance and specifies the period which is officially recognized as the duration of the disaster."

Under this system the relief program is coordinated by a Federal coordinating officer, who is charged with encouraging the maximum effectiveness of the assistance carried out by teams of disaster specialists from Federal agencies. Usually these services are offered through one-stop centers for individuals, where they may learn about all the different types of assistance available. A separate program is offered to State and local governments, Indian tribes and Alaskan native villages, rural communities and unincorporated towns or villages, or "qualifying private nonprofit institutions." A wide variety of Federal departments and agencies are involved in these activities, based upon the nature of the particular disaster and the determination made by the coordinator and the governor as to the special needs of the disaster area citizens and governments.

Even if the President does not declare a major disaster, assistance may still be obtained from the Federal Government and private organizations. The FDAA *Program Guide*[156] lists the following examples of the kinds of assistance available from Federal and private agencies (not including State aid):

Search and Rescue. The U.S. Coast Guard can assist in search and rescue operations, evacuate disaster victims, and transport supplies and equipment.

Flood Protection. The U.S. Army Corps of Engineers has the authority to assist in floodfighting and rescue operations and to protect, repair, and restore federally constructed flood-control work threatened, damaged, or destroyed by a flood.

Fire Suppression Assistance. The Disaster Relief Act of 1974 authorizes the President to provide assistance, including grants, equipment, supplies, and personnel to a State for the suppression of a forest or grassland fire on public or private lands that threatens to become a major disaster.

Health and Welfare. The Department of Health, Education, and Welfare can provide assistance to State and local welfare agencies and to State vocational rehabilitation agencies. The Public Health Service can aid States and local communities in emergency health and sanitation measures. The Food and Drug Administration can work with State and local governments in establishing public health controls through the decontamination or condemnation of contaminated food and drugs.

[155] U.S. Department of Housing and Urban Development, op. cit. note 154, p. 5.

[156] Ibid., pp. 11–12.

Emergency Conservation Measures. The county and State Agricultural Stabilization and Conservation Service Committees may designate areas eligible for the Emergency Conservation Measures program. This program provides for payments of up to 80 percent of the cost to rehabilitate farmlands damaged by natural disasters.

Emergency Loans for Agriculture. The Farmers Home Administration may make emergency loans to farmers, ranchers, and oyster planters.

Disaster Loans for Homeowners and Businesses. The Small Business Administration can provide both direct and bank-participation disaster loans to qualified homeowners and businesses to repair or replace damaged or destroyed private property when the SBA Administrator declares a "disaster loan area" under his own statutory authority.

Repairs to Federal Road Systems. The Federal Highway Administration, Department of Transportation, can provide assistance in a widespread disaster to restore roads and bridges.

Tax Refund. The Internal Revenue Service can assist individuals in obtaining tax refunds for losses resulting from natural disasters.

An essential element of almost any disaster relief effort is the assistance provided by private relief organizations in the distribution of food, medicine, and supplies; the provision of emergency shelter; and the restoration of community services. The American National Red Cross, which operates under a Federal Charter (as provided by P.L. 58–4, approved January 5, 1905, 33 Stat, 599), provides grants and other types of assistance to individuals and families in disasters to meet their emergency needs. The Salvation Army, the Mennonite Disaster Service, and other charitable organizations and church groups also provide significant assistance to those in need of help.

Another aspect of relief and rehabilitation is the role of insurance in the hazard management process. Insurance is available for loss due to most natural disasters, and the amount and cost of that insurance is, in many cases, influenced by the Federal Insurance Administration in the Department of Housing and Urban Development. The National Flood Insurance Program makes insurance available, at subsidized rates, but only where communities are working under a land-use program that aims at limiting losses in the flood plain; it also makes flood insurance available for hurricane and tsunami disasters. Private insurance is available for wind and earthquake damage, although earthquake insurance must be purchased separately. The Federal Government, through the flood insurance program, covers erosion and mudslides when they are caused by flooding, but individual losses due to these hazards are not covered; therefore, the private owner has to absorb the loss. The owner usually pays for losses from subsidence and avalanches. Of course, if any of these problems affect a large enough population, there is a possibility that the President may declare a major disaster and open the door to aid.

Insurance has the capacity to help guide the extent to which people expose themselves to risk from natural causes. As noted above, Federal aid in this area is attached to a requirement that better planning must take place at the local level. Once again, it becomes apparent that this part of natural hazard management interlocks with, and affects, all other parts of the system. The influence can be both positive, if better planning results, or negative, if the availability of insurance leads to a false sense of security and unwise development. Unfortunately, insurance availability has often had the second type of effect. When this is true the taxpayers as a whole pay for those who take risks, and lose, knowing that their insurance or the Federal Government will pay for their risk-taking.

Federal Agencies in the Natural Hazard Management System

It is impossible to include all of the Federal agencies that may get involved at some point in the relief process. For instance, when the President declares a major disaster, agencies such as the Veterans Administration, the U.S. Employment Service, and the Social Security Administration may be brought in to assist disaster victims; however, their involvement in disaster relief is secondary and temporary. The major agencies follow.

The Defense Civil Preparedness Agency (Department of Defense) funds emergency offices that in most States administer both nuclear attack and disaster preparedness programs. While there is some cooperation with other agencies involved in natural hazard management at the Federal level, the quantity and quality of cooperation in this area is small. Because of its original mandate, and because of the background of the State program staffs, the major interest of these organizations is in the civilian response to nuclear attack and only secondarily with the effects of natural disasters.[157] In fact, the *Federal Emergency Preparedness and Response Study* [158] notes that it has been asserted by many experts that:

> ". . . States and individual citizens are asking for and expecting higher levels of disaster protection and relief from the

[157] U.S. Department of Commerce, NOAA, Office of Coastal Zone Management, op. cit. note 133, p. III–25.

[158] U.S. Office of Management and Budget, President's Reorganization Project. *Federal Emergency Preparedness and Response Study*. Washington, D.C., October 1977, p. 3.

Federal Government, but seem less satisfied each year with the Federal Government's performance of its part of the shared responsibility."

Two organizations in the Department of Housing and Urban Development are involved in natural hazard management: The Federal Disaster Assistance Administration (FDAA) and the Federal Insurance Administration's National Flood Insurance Program. FDAA has been delegated the responsibility for administering the Disaster Relief Act of 1974 (P.L. 93–288).

Under Section 201 of this Act, FDAA administers a program of preparedness grants to the States, as discussed earlier. The primary emphasis of this program has been on increasing the States' capability to respond to disasters and emergencies, including preparation of a State Emergency Plan, but States can conduct vulnerability analyses and plan for hazard mitigation. The States have performed some mitigation functions (e.g., supporting appropriate State emergency legislation, encouraging community participation in the National Flood Insurance Program, and reviewing land-use practices and building codes). In the future, after a President has declared an emergency or major disaster, States will be urged under Section 406 of the Act to review the hazards to which their communities are exposed and, with local participation, agree on appropriate mitigation actions. If, for example, affected communities agree to adopt and enforce more stringent codes, the additional costs incurred in reconstructing public facilities as a result of such codes may be reimbursable by the Federal Government.

Also in the Department of Housing and Urban Development is the National Flood Insurance Program. The program establishes criteria for community inclusion in the Flood Insurance Program and then requires the purchase of flood insurance, in communities where it is available, before any Federal financial assistance can be received. The program was weakened by the Housing and Community Development Act of 1977. The Act removed a provision that prohibited Federally regulated lending institutions from making any loan secured by improved real estate or a mobile home located in an area having special flood hazards, if the community is not participating in the National Flood Insurance Program. It provides instead that such lending institutions notify a purchaser or lessee obtaining a loan secured by real property in a designated special flood hazard area as to whether disaster relief for that property is available in the event of a flood disaster.[159]

[159] U.S. Department of Housing and Urban Development. *Summary of the Housing and Community Development Act of 1977.* Washington, D.C., October 1977, pp. 20–21.

A major part of the National Flood Insurance Program is the identification of flood-prone areas. This program has been going forward with the help of other Federal agencies involved in hazard mapping. Groups in the Department of Agriculture, U.S. Geological Survey, NOAA, the Corps of Engineers, and the Water Resources Council (a cabinet-level coordinating body) also are operating in this area. The President, through Executive Order 11296, attempted to strengthen the planning for flood disasters by ordering that new facilities should be placed, as far as practicable, outside areas of flood hazard. However, a report from the General Accounting Office regarding national attempts to reduce flood losses indicated that Federal agencies have been less than diligent in some places in complying with the President's order.[160]

Several agencies within NOAA participate in hazard management. The agency with the longest history of involvement is the National Weather Service because of its role as weather forecaster. Prediction and warning systems are operating for all atmospheric hazards and for the flooding that may occur as a result. In addition, the Weather Service has a Disaster Preparedness Program that coordinates the work of meteorologists in the field who help communities prepare plans for coping with all sorts of weather-related disasters.

The Coastal Mapping Division of the National Ocean Survey is carrying out a long-term program of preparing maps of high-water evacuation routes from vulnerable coastal areas. As mentioned earlier, these maps feature high-resolution relief so that local disaster officials can choose the most suitable evacuation routes to safety inland. Progress is slow in preparing the maps, and they cover only part of the total hazard problem. Also, their cost is high, and they are printed in relatively small quantities.

A task force has been formed within the National Oceanic and Atmospheric Administration to identify ways of strengthening the organization's involvement in natural hazard planning and preparedness, particularly in relation to hurricanes as they affect the coastal area.

The U.S. Geological Survey is active in a wide variety of mapping for flood, earthquake, landslide, volcano, and subsidence hazards.[161] It is also the lead agency in the development of monitoring and warning systems for geological hazards. With the passage of the "Earthquake Hazards Reduction Act of 1977" (P.L. 95–124), the level of these activities

[160] U.S. General Accounting Office. *National Attempts to Reduce Losses from Floods by Planning for and Controlling the Uses of Flood-Prone Lands.* Washington, D.C., March 7, 1975.

[161] U.S. Department of the Interior, U.S. Geological Survey. *Directory to U.S. Geological Survey Program Activities in Coastal Areas, 1974–76.* Washington, D.C., 1976.

within USGS may increase dramatically, and the need for communication and coordination between it and other agencies will grow accordingly.

Hazard mitigation as an emphasis may be given a major boost by P.L. 95–124. This law, being implemented by the Office of Science and Technology Policy, seeks to improve preparedness and response planning for earthquakes, with the emphasis on preparedness through: (1) technically and economically feasible design and construction methods, procedures, and codes; (2) land-use planning; (3) earthquake prediction and control; (4) communication to, and education of, the public; and (5) appropriate research of physical, engineering, and social science problems. The implementation plan for this law is currently in draft status.

Since 1824, the Corps of Engineers has been in charge of improving rivers and harbors, and this has included almost all of the Nation's levees, dams, and other protective structures. (The Bureau of Reclamation is involved in multipurpose water projects in the western States.) Since 1955, when P.L. 84–71 authorized such activities, the Corps of Engineers has made well over 100 studies on hurricanes and shoreline protection. About half of these studies have led to projects such as seawalls, revetments, breakwaters, groins, and bulkheads to prevent the passage of storm surge.[162] These structures often have unanticipated ecological consequences; therefore, the use of structural protection rather than other nonstructural possibilities (purchase of susceptible land, setback rules, preservation of natural protective features, and other techniques) may be questionable.

Throughout the literature on natural hazard management there is a constant plea for greater coordination among all Federal agencies. Just as natural hazards often come in groups, the management and mitigation of natural hazards can only be accomplished through consideration of all aspects of preparation, mitigation, protection, and recovery. Yet the reorganization task force examining disaster preparedness and response reports that the current Federal structure frustrates the development and implementation of a coherent approach by: [163]

- Issuing confusing and inconsistent policy interpretations and change(ing) them unpredictably;
- Failing to articulate and coordinate the relationships between preparedness and response activities;
- Failing to provide a single point of contact for State, local, and private individuals and organizations;
- Perpetuating duplicative administrative requirements and excessive paperwork; and
- Failing to provide a comprehensive overview of resource allocation and use.

With clarification of national policy toward natural hazard management and the establishment of a set of priorities for accomplishing the goals of that policy, the numerous Federal programs can function more efficiently and their effectiveness can be better evaluated. This procedure also can lead to better cooperation with State and local agencies in the field. Natural hazards will always exist, but their capacity to turn into catastrophies is inversely related to the understanding and consideration of their existence by those charged with protecting the public.

[162] U.S. Department of Commerce, NOAA, Office of Coastal Zone Management, op. cit. note 133, p. II–14.

[163] U.S. Office of Management and Budget, President's Reorganization Project, op. cit. note 158, p. 3.

Siting of Energy Facilities in the Coast

Introduction

Among the most controversial coastal issues are the siting of energy facilities, including offshore oil and gas projects, oil port facilities, liquefied natural gas terminals, onshore electrical generating stations, and offshore nuclear powerplants.

Traditionally there was little debate about siting such facilities. Industry would decide the need, location, and timing, and government would review the proposal to ensure that it met basic safety and antitrust standards.

Today, however, there is political controversy about both the substance of siting—what facilities should go where, and when—and the process by which private industry and government decide such matters. Major political fights have broken out, such as battles over where, when, and how to lease offshore oil lands and whether to use nuclear powerplants. While these debates take place all over the Nation, they are particularly intense in coastal areas, where development pressures already are strong, but where industry and Federal agencies want to locate many of the new energy facilities deemed necessary to meet the country's future energy needs.

If there is a common theme through these debates, it is that States and citizens want a more thorough consideration of energy alternatives, that they do not want to accept automatically industry or Federal proposals for fear that important options about location, safety, and environmental safeguards may be neglected. The debate involves questions of community lifestyles and priorities. Citizens' groups have become more activist, pushing for discussion of these issues. They are redefining their role in energy decision-making and are pushing for new siting legislation that formally recognizes their new role in siting decisions.

Shortcomings of the Older Laws

In recent years energy facility siting has become a major issue. One reason is that there now are new energy technologies and associated debate over how they should be planned and licensed. Offshore deepwater ports are an example. Before 1974 there was no clear procedure for siting these facilities outside the 3-mile limit. The resulting debate led to the Deepwater Port Act. Now there are debates about whether new licensing procedures are needed for such technologies as liquefied natural gas.

But a larger reason for controversy is that industry, the public, and the States are critical of the older siting procedures. James Sundquist has written a summary of the role industry plays under these older procedures, how the public now often reacts, and government's traditional methods for trying to resolve the conflicts.[164,165]

> "The site selection process is as follows: The utility decides in secret what the energy requirements of the area it serves are. Then in secret it decides whether it will propose a nuclear plant—what kind of a nuclear plant and how big—or a coal-fired plant or something else. Then, again as surreptitiously as possible, it surveys its area and picks out a site. At this point it springs its decision on the people. The people in the area at once get organized. Sometimes they lie down in front of a bulldozer as they are doing in New Hampshire [at the site of the proposed Seabrook nuclear plant], but in any case they organize. Then an adversary process begins, with the utility on one side and the opponents on the other. Either an administrative body or a court—or, eventually both—acts as judge, but public agencies may also intervene on one side or the other. There have been cases where one State agency has intervened on one side and another State agency on the other, to reinforce both sides. In any case, the long adversary process, moving from one tribunal to another and employing judicial or quasi-judicial procedures, can drag on for years."

This description summarizes some key points. One is that traditionally industry has had the lead role in deciding siting matters. It decides not only the location but other overall siting decisions: when a facility is needed, what kind of fuel and design should be used, and timing. Sometimes industry must conform to guidelines set in advance by Government, such as design criteria for nuclear reactors, but in general Government's role has been limited to reviewing industry's proposals *after* the companies have made the key decisions and have invested considerable time and money in a particular unit for a particular site.

The people's opposition stems from one or both of two reasons. One is opposition to the specific proposed site itself. Many may feel that a facility will be too destructive of the environment or too close to populated areas to be safe. But citizens also can criticize "larger" issues, such as whether a given reactor design is safe.

Public groups often feel that a given proposal is not the best that could be made, that important considerations and alternatives have been neglected, and that therefore—and this is a key point—citizens themselves should play a larger role in deciding these matters. In fact, much of the public now feels that energy facility siting is too important to be left solely to the companies.

A major problem, though, is that traditional Government procedures often do not resolve these kinds of disputes. Government licensing proceedings usually are quasi-judicial and, on a case-by-case basis, geared to judge whether a particular proposal is in accordance with legislative standards regarding antitrust, safety, and financing. They stem from an era when Government's role was to give a "go" or "no go" decision to industry, not to arbitrate conflicts between industry and the public, or resolve situations where the public does not agree among itself over whether a particular plant is necessary, designed properly, or located in the right place.

In recent years, citizens, States, and communities, frustrated by the lack of other forums to raise such "larger" issues as the safety and need for nuclear power, have tried to raise these matters during the usual case-by-case licensing proceedings. When they are dissatisfied with how the issues are addressed, they go to court to get a fuller discussion or to block certain facilities outright. Some Government agencies have sided with citizens groups; other, particularly energy agencies, have sided with the companies.

The regulatory agencies are caught in the middle. It often is difficult for them to carry out the functions desired by the environmentalists; they are now called upon to judge policy matters—such as coal versus

---

164 James L. Sundquist. "Commentary," in Erasmus H. Kloman, coordinator, *The Federal System and Energy Facility Siting*. Washington, D.C., National Academy of Public Administration, 1977, pp. 45–56.

165 For another discussion of these issues see: Luther J. Carter. "Virginia Refinery Battle: Another Dilemma in Energy Facility Siting," Science, 199, February 10, 1973, pp. 668–671.

nuclear energy—that lie outside the scope of their expertise and jurisdiction.

Industry also is frustrated, particularly by the fact that it is taking longer to obtain permits at a time when more permits than ever are required. They are angered by the lack of coordination among government agencies and by the time and money required to license a facility. There is concern that new facilities may not be ready when needed.

Recent Developments

It is clear to Congress and others that simply changing siting procedures will not magically settle major political disputes over energy facilities. It also is clear that any new siting procedures must operate within a political system that emphasizes both federalism and a strong role for private companies. Given these imperatives, the new siting laws and other procedural changes of recent years are seen as a better way to discuss and channel disputes, not as a panacea for resolving energy debates. These changes are still new and vary a great deal, but several basic trends can be seen. In particular, they reflect a new willingness to consider alternatives and to involve the States and public more in siting matters.

On one level, Government has been trying to resolve the substantive issues which have received attention from the public. For instance, agencies are looking at alternative approaches to locating these facilities—such as energy parks, where a number of facilities are concentrated to cut down the need for multiple sites; remote siting for some dangerous kinds of plants, such as liquefied natural gas terminals; and even offshore sites for some types of facilities. Larger ("generic") issues such as which facilities are needed, reactor safety, and basic environmental safeguards are being addressed on other than a case-by-case basis.

There are also some major changes in the *process* that addresses such issues and makes the siting decisions. These changes in process are reflected in such new laws as the Deepwater Port Act, the Coastal Zone Management Act, and the proposed Outer Continental Shelf Lands Act Amendments (of 1978). Some key elements of these laws are:

1. Siting processes (which include both the planning and licensing of facilities) are designed so that these "larger" issues are addressed *before* regulatory agencies consider specific proposals. This is done so these issues need not be brought up in each case. "Larger" policy issues can be addressed through agency rule-making hearings, executive task forces, or new legislation.
2. The siting processes also are designed so that a particular proposal is reviewed by the Government *before* a company invests a great deal of time and money on a specific design and site. The idea is to discuss possible objections to the site as early as possible. One technique is to guide the companies before they make their preliminary decisions; this is done through special guidelines (also known as "performance standards" or "siting criteria") which tell companies in advance what kinds of facilities will be allowed on what kinds of sites. Another approach is to require early disclosure of company plans. A third, used in Maryland, is for the Government itself to select sites in advance.
3. They often help facilitate public participation in government proceedings, sometimes to the extent of providing financial assistance to citizen groups.
4. They seek to improve the coordination of permit processes and to expedite licensing proceedings. This is done by establishing clear-cut agency jurisdictions, requiring agencies to establish interagency coordination procedures, and specifying deadlines for reaching decisions.

Examples of these new trends can be seen by looking at the new or proposed laws for siting specific kinds of energy facilities.

Siting of Particular Kinds of Coastal Energy Facilities

Oil Tanker Facilities, Including Deepwater Ports

The siting of tanker terminals, including offshore deepwater port facilities, illustrates the strengths, limitations, and administrative costs of the new type of siting processes.

Issues and Processes for Onshore Terminals.

Tankers play an important role in the transportation of this country's energy supplies. About half of the oil this country now consumes is imported, most of it by tanker, much of it from the Middle East. In addition, there is considerable shipment of oil in the domestic coastal and inland trades, though pipelines still play the predominant role in domestic petroleum transportation.

Today, much attention focuses specifically on the role of tankers carrying Alaskan oil to the rest of the country. The key issue is whether to build new tanker terminals on the West Coast, with connecting pipelines to carry the oil to the Midwest, or to carry the oil not used by the West Coast to the East via tanker and the Panama Canal. Political interest in this issue runs high. The discussions come at a time of high concern about the safety and environmental

effects of these ships; memories of the *Argo Merchant* oil spill and other recent accidents are still strong.

Decisions about how to transport Alaskan oil will have important implications. Even if a major West Coast terminal and pipeline are built, by the early 1980s close to half of the total U.S. domestic oceanborne transportation of petroleum will be for Alaskan crude. Yet, without a West Coast pipeline, requiring use of the Panama Canal, the Alaskan trade could rise to as much as two-thirds of the total domestic ocean movement of oil by the early part of the next decade.[166] Furthermore, the cost of using the Canal option certainly will be much higher.

There are two major options for West Coast terminals and pipelines: the Northern Tier pipeline from Port Angeles, Wash., or an alternative site near Puget Sound, Wash., to Clearbrook, Minn.; and the Standard Oil of Ohio (Sohio) pipeline from Long Beach, Calif., to Midland, Tex. All of the proposals are controversial.[167]

The Sohio proposal is an interesting current example of the siting process for onshore tanker facilities. As in the case of other facilities, the company made basic decisions about what project and site to propose. In this case, the proposal was approved by both the Interior Department (which controls the public lands over which the new sections of pipeline would be built) and the California Coastal Commission. Sohio's problem has been getting approval from California's Air Resources Board, which is concerned about how evaporating hydrocarbons from the terminal would add to Southern California's air pollution problems. The Air Board has said that Sohio can build the proposed facility at Long Beach only if it takes steps to reduce air pollution from certain other sources in the Los Angeles area, at an estimated $100 million cost.

This is not simply a case of a State agency trying to block a project seen by many as being in the national interest. The Air Board is acting under the Federal Clean Air Act, which sets strict standards when new projects are to be allowed in areas with high air pollution; it also is acting in what it sees as the clear interest of the State and region. The board is investigating alternative sites where the air pollution is less severe. The views of local residents will come into play if the State proposes alternative sites in relatively undeveloped areas.

Another tanker subject that is receiving considerable attention is the matter of deepwater ports, that is, ports in water deep enough to accommodate today's supertankers. The need for such facilities is particularly strong along the East and Gulf coasts, although there is some argument in favor of sites in neighboring areas of the East coast (Canada and the Bahamas). In 1974 some 80 percent of all U.S. oil imports were landed along these two coasts, and this percentage is expected to continue. In this age of supertankers, the maximum size tanker which can be accommodated fully laden at most East and Gulf coast ports is 55,000 deadweight tons.[168] However, in 1975 more than three-fourths of the total world tanker capacity was in vessels exceeding that tonnage.[169]

Given this situation, one option is to continue to use "lightering" techniques, where large ships anchor offshore and the oil is offloaded onto smaller ships or barges which can carry it into port. But this is costly and can add to the oil spill problem. Another option is to build deepwater ports, either by expanding existing ports through dredging or building ports offshore.

Expansion of existing ports probably will be most feasible along the West Coast, which already has several fairly deep ports.[170] There also have been proposals to expand the ports of Galveston and Corpus Christi, but both of these projects would require massive dredging in order to make the now shallow channels deep enough for supertankers. This has led to interest in offshore deepwater ports.

Issues and Processes Regarding Offshore Deepwater Ports

Generally an offshore deepwater port is a single buoy or some similar unit anchored several miles off a coast. The supertanker is tied up to the unit, and the oil is shipped ashore through underwater pipelines that connect the unit with the coast.[171]

In the early 1970s, it was found that while there was sufficient legal authority to site offshore units within the 3-mile limit (though many agencies would be involved), it was not clear whether there was any authority to site them outside the 3-mile line or what the procedures for doing so might be.

Such concern led to the passage of the Deepwater Port Act of 1974, one of whose purposes is to "authorize and regulate the location, ownership, construction, and operation of deepwater ports in waters beyond the territorial limits of the United

---

166 From calculations based on data from: U.S. Department of Commerce, Maritime Administration, Office of Policy and Plans. *The U.S.-Flag Tanker Fleet and Domestic Carriage Requirements—An Assessment of Fleet Adequacy*. Washington, D.C., October 21, 1976.

167 Ibid., pp. 25–34.

168 U.S. Congress, Office of Technology Assessment. *Oil Transportation by Tankers: An Analysis of Marine Pollution and Safety Measures*. Washington, D.C., Government Printing Office, July 1975, pp. 13, 24.

169 Sun Shipbuilding Company. *World Tank Ship Fleet*. Appendix Table 5B, 1975.

170 Office of Technology Assessment, op. cit. note 168, p. 24.

171 For a good discussion of the technology and some recent proposals see: U.S. Congress, Office of Technology Assessment. *Coastal Effects of Offshore Energy Systems*. Washington, D.C., Government Printing Office, November 1976, particularly pp. 173–196.

States." In many ways it is a model of the "newer" approach to the siting—particularly the licensing component—of energy facilities. Some key features are:

1. *Coordination.* The law designates the Department of Transportation as the "lead agency" for licensing deepwater ports outside the 3-mile zone. In addition, it clearly lists the jurisdictions and responsibilities of the various Federal agencies involved and establishes specific procedures and deadlines for coordinating their actions. The statute also provides for an unusual, but clear-cut, way of coordinating State and Federal viewpoints: no Federal license shall be issued without the approval of the governor of each adjacent State.
2. *Performance standards.* The law sets forth the conditions which must be met before the Secretary of Transportation may issue a license (it must be in the national interest, meet environmental criteria, meet antitrust requirements, etc.) and also directs the Secretary to prepare environmental review criteria for use in evaluating applications.
3. *Public participation.* The Act explicitly provides for public access to information about the applications, for public hearings, and for judicial review and citizen civil action.

The Act also settles some substantive policy matters that might otherwise be brought up during the review of individual applications; one is the question of liability for oil spills from the ports, which is settled by establishing a Deepwater Port Liability Fund.

Two groups have applied for licenses under the Act. In both cases, licenses have been offered, subject to the applicants' meeting specified conditions. The conditions, dealing largely with antitrust and financing matters, are considered strict by the industry.

In August 1977 the five firms which make up the Louisiana Offshore Oil Port (LOOP) consortium accepted the terms and conditions of their license. It is now expected that construction will start sometime in late 1978, with completion of the first stage in 1980 and two additional stages later. Located in water more than 100 feet deep, LOOP will be able to handle tankers of up to 750,000 deadweight tons, which is about half again as large as the biggest tanker in the world today.

Outer Continental Shelf Oil and Gas

The process for leasing offshore oil tracts, permitting their development, and siting associated offshore pipelines and onshore facilities has been debated intensely in recent years. The reason is that many States and others have felt that the present process does not adequately deal with important issues such as environmental safeguards and the timing of the development.

Substantive Policy Issues

States and citizens argue that until recently the Interior Department, which leases offshore tracts to industry, has not listened to them fully, or adequately addressed the policy issues that bother them. These are the issues of information (the States want information on the tracts being considered for lease and, later on, information on industry's plans to develop the areas it has leased), timing (States and citizens want time to review proposed plans, comment on them, and plan to handle associated onshore development), selection of sites (they want Interior to consider exempting environmentally important areas from lease sales), environmental safeguards, and financial arrangements. Because these issues have not been addressed to their satisfaction, they have often used court suits to block lease sales and have pushed for a larger role in OCS decisionmaking.

The Siting Process

Pending in Congress is legislation that would: (1) address the substantive policy issues of concern to the States; (2) also address some other policy issues of national concern, particularly the questions of oil spill liability, the role of government in exploratory drilling, and how to modify the bidding system for lease sales to ensure that the government receives maximum payment for these publicly owned resources; and (3) change the leasing process to increase the amount of information gathered and distributed, give the governors a larger say in the locations and timing of lease sales (though not a veto over Federal decisions), and, in accordance with the Department of Energy Act, tie leasing schedules more closely to overall national energy policy.

The two bills revising the Outer Continental Shelf Lands Act of 1953, similar in nature and both containing these basic provisions, are S. 9, passed by the Senate in July 1977, and H.R. 1614 passed by the House in February 1978.

Liquefied Natural Gas (LNG) Facilities

LNG is a classic example of where a fragmented regulatory process based on the "traditional" approach to siting has led to problems.

Substantive Policy Issues

Shipments of liquefied natural gas imported via tankers are expected to become increasingly important to the United States. In 1976, total U.S. natural gas consumption was slightly under 20 trillion cubic feet. In that year, with only one LNG project operat-

ing in this country (Algeria to Everett, Mass.), only about one-twentieth of 1 percent of United States consumption came via LNG tanker. But it has been suggested that by 1985 as much as 5 to 15 percent of total American gas supplies may come from LNG imports.[172]

Increased LNG imports are the product of rising energy prices, declining domestic production of natural gas, and the ample availability of gas in certain other regions of the world. The only practical way to tap these distant sources is to convert the natural gas to liquid at the source, transport the liquid in special cryogenic tankers, and then regasify the liquid at a special receiving facility and distribute it to users. The cost of these LNG projects is enormous.

As more and more large LNG projects are proposed and approved, public concern has grown about the safety of LNG transportation and the wisdom of importing large amounts of gas from a few suppliers, particularly Algeria and Indonesia. The safety question is a complicated one. Two major accidents have involved LNG since 1944. Experts have testified that one was due to poor design, inadequate installation, faulty manufacturing, and inadequate inspection of the onshore storage facility. While LNG ships and terminals are regarded as very well designed, the Office of Technology Assessment and others have suggested that questions about ship design, crew training, and vessel traffic control around LNG terminals be investigated further. Also, the Federal Government has yet to formulate a policy on the amount of LNG that should be imported, whether sources should be diversified, or even how the gas will be priced once it arrives in this country.

The Siting Process

The process for siting LNG facilities is fragmented, with agency jurisdictions unclear, and with basic policy questions about import policy, siting criteria, safety, and pricing yet to be resolved. LNG decisions continue to be made on a case-by-case basis, by agencies that are not now geared to resolving larger issues.

Several proposals to revise this regulatory phase of the LNG siting process are now being discussed in Congress. One is the Senate Commerce Committee Staff Working Paper No. 1 of November 12, 1976. Two others are Congressman Dingell's H.R. 6844 (May 3, 1977) and Senator Pell's S. 2273 (November 1, 1977). All three essentially would require the government to set safety standards and siting criteria and would require Federal licenses before construction or operation of an LNG facility. The first two proposals would give these responsibilities to the Secretary of Transportation; the Pell bill to the Secretary of Energy. All three also would give the States a strong say in the siting of LNG projects.

In general, industry appears to oppose such bills, feeling that: (1) they would add an additional, unnecessary layer of bureaucracy to the licensing process and (2) by adding new ground rules would add uncertainty and hence delay into current LNG licensing proceedings. However, it is also clear that industry wants changes in the current process, particularly streamlining the approval process and resolution of the pricing issue.

Other Onshore Energy Facilities

These include nuclear powerplants, fossil fuel powerplants, oil refineries, petrochemical facilities, and related facilities such as electrical transmission lines. State and local authorities play the largest role in the licensing phase of the siting process for these, though the Federal Government has a large role in licensing nuclear units.

It is likely that there will be proposals to build many more of these various facilities in coastal areas, since, generally, population and need for energy are growing in these places and they have abundant cooling water and good transportation links. Yet it also is likely that the proposals will be controversial, given today's concern about protecting the coastal environment and a desire to use coastal areas for other purposes, such as recreation.

States now want much more say in determining whether a facility is needed and where exactly it should be sited. This view is reflected in the new laws passed by a number of States, changing the way these units are sited.

There is great concern about the issues associated with nuclear plants, issues such as management of radioactive waste, location near populated areas, and so forth. These policy issues, which many people feel are unresolved, have been brought up in hearings on individual applications and are a factor in the increasing development time for nuclear plants with land locations.

There is now considerable discussion about how to change the nuclear siting process. The Nuclear Regulatory Commission has prepared a major study of the issue.[173] The Department of Energy also is concerned about delays in getting nuclear projects

[172] U.S. Congress, Office of Technology Assessment. *Transportation of Liquefied Natural Gas.* Washington, D.C., Government Printing Office, September 1977, p. 5. This source provides an excellent recent summary of U.S. LNG policies and projects and is particularly useful in its identification of the major safety issues associated with LNG transportation.

[173] U.S. Nuclear Regulatory Commission, Office of State Programs. *Improving Regulatory Effectiveness in Federal/State Siting Actions.* NUREG–0195, Washington, D.C., May 1977. This is an excellent summary document from a series that has nine other volumes.

approved. The Carter Administration is now revising its proposed "Nuclear Siting and Licensing Act." It also is preparing a "Comprehensive State Siting Act" to require the States to do additional energy planning and to provide special Federal assistance to the States.

Floating Offshore Nuclear Powerplants

Substantive Policy Issues.

The idea is to build nuclear powerplants at a manufacturing facility, barge them to a site several miles off the coast, anchor them within an artificial breakwater while connecting them to the shore through underwater electrical lines, and then use them as a major source of electrical power. The perceived advantages are two-fold. One is that it is easier to site them, because there is plenty of offshore space at a time when it is politically difficult to find sites onshore. Another is that building these plants on an assembly line will permit "standardization" of the reactor design, something which may increase quality control and lower costs. Now each nuclear powerplant is built separately, on site, without standardization.

Two companies are proposing to build the world's first offshore nuclear system. Offshore Power Systems, a subsidiary of Westinghouse, has begun a manufacturing facility at Jacksonville, Florida. Public Service of New Jersey, a major utility, has contracted for two plants to be built by the Jacksonville plant for an offshore Atlantic Generating Station near Atlantic City. Neither company has received the necessary permits to begin work.

In this first case, there are both generic and site-specific considerations. One generic issue deals with how safe and reliable offshore plants are compared with land-based units, and particularly what safeguards might be needed to prevent or contain an accident where a melted reactor core fell into the water and the radioactive material spread. The Nuclear Regulatory Commission and other are studying this question.

Another generic issue is whether floating plants should be located near those coastal waters that are used for other purposes, such as fishing or shipping. Siting criteria and planning may be desirable if it appears that large numbers of these plants will be deployed.

There are also questions about the particular site that Public Service is proposing. Chief among the concerns is that the plant would be near an area popular with summer tourists and difficult to evacuate in case of emergency.[174]

The Siting Process

The main agency involved is the Nuclear Regulatory Commission, which like other Federal agencies, reviews the proposals submitted by industry and, if they meet the criteria, issues the necessary permits. In this case, three main permits are involved: a manufacturing license to build the Jacksonville facility, a construction permit to begin the Atlantic Generating Station, and later an operating license for the station. Given recent delays in the project, it is unclear when these permits may be used. In addition to the NRC permits, Public Service will need Army Corps of Engineers dredge permits, Coast Guard approval of the barges holding the reactors, and various other Federal, State, and local permits.

There now appears to be little serious criticism of this siting process, perhaps partly because NRC is proceeding carefully, allowing time to consider such generic issues as the results of an unlikely, but still possible, meltdown accident.

However, the Office of Technology Assessment and others have expressed concern that the present siting process may not be well equipped to handle the large-scale deployment of floating plants, partly because there now is no mechanism for developing general siting criteria for them, partly because something analogous to the Deepwater Port Act may be needed if floating powerplants are to be located outside the 3-mile limit of State jurisdiction.[175]

The Role of Coastal Zone Management in the Siting of Energy Facilities

The Coastal Zone Management Act Amendments of 1976 deal primarily with energy matters, Outer Continental Shelf oil and gas in particular. The amendments give the Coastal Zone Act these energy facility siting features.

1. *Planning.* The 1976 changes add a new section (305(b)(8) that requires:

> "(8) A planning process for energy facilities to be located in, or which may significantly affect, the coastal zone, including but not limited to, a process for anticipating and managing the impacts from such facilities."

Several premises seem to be behind this provision. One is that by requiring States participating in the coastal zone program to plan in this area, the resulting State coastal program will provide guidance to both companies that wish to site facilities and State officials who will have to pass judgment on their applications. Furthermore, coastal zone programs are seen as able to discuss tradeoffs and alternatives because they consider a range of energy facilities and a range of social concerns (unlike air and water quality plans, for instance, which focus on one matter), are concerned with coordinating

[174] U.S. Congress, Office of Technology Assessment, op. cit. note 171, particularly pp. 197–237.

[175] Ibid., pp. 99–101 and 106–111.

State and local policies, and can consider various alternative sites for energy facilities. On the other hand, this very breadth of concerns can be a weakness when it comes to settling difficult energy siting questions.

2. *Federal-State coordination.* The amendments make two changes in this area. Section 306(c)(8), which requires that no plan be approved that does not provide for "adequate consideration of the national interest," is now expanded to treat energy facilities more explicitly. Now before approving a program, the Secretary of Commerce shall find that:

> "(8) The management program provides for adequate consideration of the national interest involved in planning for, and in the siting of, facilities (including energy facilities, in, or which significantly affect, such state's coastal zone) which are necessary to meet requirements which are other than local in nature. In the case of such energy facilities, the Secretary shall find that the State has given such consideration to any applicable interstate plan or program."

Second, section 307, the "Federal consistency" provision, is amended to require that oil company plans submitted to the Secretary of the Interior for any exploration, development, or production on the Federal OCS be consistent with a State's approved coastal management program.

Several premises appear to be behind this approach to Federal-State coordination. One is that there is an implicit trade here between Federal and State agencies, and that making this trade will improve cooperation between the two levels of government. The trade is that in exchange for the State "adequately" considering the "national interest," the Secretary of Commerce will approve the State Coastal Program and other Federal agencies will abide by its guidelines. The crucial role of local governments in this process adds a complicating factor.

The unresolved question, of course, is whether the coastal zone management approach will work—whether it will improve coordination and planning, and whether this, if it occurs, will lead to "better" decisions and resolve political differences in a timely and constructive way. As time passes, one way to evaluate the success or failure of the coastal zone management approach will be to see how it succeeds in dealing with particular facility siting issues.

The California Lawsuit

A recent lawsuit in California has become a test of what coastal zone management will be in practice, and particularly what its role will be in the siting of energy facilities. It also illustrates some of the confusion and difficulties that accompany an actual effort to put a "newer" style energy-siting process into operation.

The suit is *American Petroleum Institute, et al. vs. Knecht, et al.*[176] The oil companies that filed it seek to block Federal approval of the California coastal program on the grounds that both it and the environmental impact statement prepared on it are incomplete.

The suit does not deal with the legality of the California program itself, which was established by the California Coastal Act. Rather the suit seeks to block Federal approval of the program.[177]

The companies argue that the California program is incomplete for two reasons, and thus should not be approved under section 306 of the Coastal Zone Management Act.[178] One deficiency, they argue, is that while it creates guidelines and a process for developing a State coastal "management program," it does not actually contain such a program. In effect, they say that it is not detailed enough, that it should not be approved until localities develop their specific plans under the State law.[179] California and the U.S. Department of Justice, representing the Commerce Department, disagree, saying that the present guidelines and process for administering them more than meet the requirements of the CZMA.

Second, the companies argue that the present California program does not provide for "adequate consideration of the national interest" in the siting of energy facilities, citing that there is nothing in the California Coastal Act that explicitly calls for con-

[176] The complaint was filed on September 9, 1977, in U.S. District Court. A September 12 temporary restraining order from the court blocked approval of the California program by the Secretary of Commerce until a hearing could be held. On October 7, after hearings, the temporary restraining order was modified to allow the Secretary to approve the program, which was subsequently done, but with the proviso that section 307 provisions requiring Federal actions to be consistent with the State program will not become effective in California's case unless and until the court rules that the program is indeed complete. Court proceedings are continuing under Judge Robert J. Kelleher of the U.S. District Court in Los Angeles.

[177] The California Coastal Act itself is an important example of the "newer" approach to siting and to land use in general. It includes detailed performance standards to guide both applicants and the regulators. It establishes procedures for coordinating the Coastal Commission with other State agencies, including the California Energy Commission. There are provisions facilitating public participation. It coordinates State and local government by allowing for delegation of coastal planning and the authority to issue permits to qualified cities and counties, while providing for appeal to the State commission. California also has passed a special law to expedite the selection of an LNG site along the State's coast.

[178] Aside from arguing that the California program does not meet CZMA requirements, the companies also argue that approval should be blocked because: (1) the environmental impact statement on the program is inadequate because it did not discuss the possibility that California will use its consistency powers under section 307 to delay or veto OCS development and (2) the Office of Coastal Zone Management did not use correct procedures in approving the program, because it did not consider all the relevant evidence.

[179] "Plaintiffs' Trial Brief," *American Petroleum Institute vs. Knecht*, pp. 56–59.

sideration of the national interest.[180] State and Federal officials, however, say that the California Act does establish clear-cut procedures for considering energy facilities and that it it acknowledges that some facilities may need to be sited even if there is environmental deterioration.[181]

The companies' brief also discusses the concerns behind the lawsuit. They feel that the California program is not explicit enough or detailed enough to give them any degree of certainty that their facilities will be allowed.[181]

> "An adequate management program requires certainty—particularly in the energy field, an area of recently expressed Congressional interest. . . . (T)he general policies of the Coastal Act on this topic are devoid of any specific commitments to energy development which would accommodate the national interest and meet the requirements of the CZMA."

They also argue that the program is so vague that it "provides no guidance or basis of predictability for oil and gas producers who must submit plans that are consistent with and must be operated in compliance with the (program)."[182] In short, they want assurances that California will not try to block their OCS operations, and they do not like the California program because it offers no such certainty.

California argues that it is not "anti-energy," as the companies assert, and that what it wants are reasonable energy projects with environmental safeguards. More to the point in this lawsuit, State and Federal attorneys argue that:[184]

> "the CZMA does not require such a 'legally enforceable' commitment (to accommodate the national interest in the siting of energy-related facilities) but only procedures for ensuring 'adequate consideration' of the national interest and that the State's program fully satisfied this requirement."

There is also the argument that there are other "national interests" to consider besides energy, including environmental protection.

The Federal brief also argues that the companies' allegations that California will somehow abuse or misuse its program are "legally irrelevant."[185]

> "Even were the plaintiffs correct (about possible abuse), the remedy is not to withhold approval of an otherwise valid Program, but to seek redress after approval against the individuals who are acting unlawfully under it either under the CZMA or in the courts."

Also contained in these briefs is an important policy question: will this California program, whether approved completely at the Federal level or not, actually help improve siting decisions, or will it, as the companies assert, only add to the confusion, lead to more court suits over what the statutes mean, and give States new powers to block needed national energy projects?

One part of the final environmental impact statement on the California program sums up the argument of the proponents of coastal zone management —and hence of what is called the "newer" approach to siting:[186]

> "It is . . . likely that the 305(b)(8) (energy planning) and 307 (consistency) provisions of the CZMA would work together to provide greater certainty and predictability for those applying for energy facility permits, and eventually speed up the permit procedure."

Perhaps at the heart of this issue is the question of the strengths and limitations of "performance standards" ("siting criteria") of the type used in the California program. From the point of view of those who propose them, their preparation is not only a way to resolve political disagreements and formulate basic policies, but also a way to avoid the need for raising "generic" matters in individual cases and to give guidance to both applicants and regulators. The State of California brief for this case discusses the advantages of making land-use decisions on the basis of performance standards instead of detailed zoning maps:[187]

> "Increasingly, the traditional zoning ordinance approaches have been found to be too rigid and inflexible for modern development activities. The traditional zoning ordinance does not provide an adequate means for responding to specific site conditions or specific attributes of a particular [proposed] development. Accordingly, many governmental entities have shifted from the rigid zoning definitions of the past to regulatory systems that define general permissible types of uses that will be reviewed in accordance with development and resource protection standards and criteria. This is the approach of the California Coastal Management Program."

---

[180] Ibid., pp. 62–64.

[181] "Federal Defendants' Motion for Summary Judgment and Memorandum of Law in Support of Motion for Summary Judgment," *American Petroleum Institute vs. Knecht*, particularly p. 51.

[182] "Plaintiffs' Trial Brief," op. cit. note 179, p. 113.

[183] Ibid., p. 57.

[184] "Federal Defendants' Motion...," op. cit. note 181, pp. 7–8.

[185] Ibid., p. 47–47n.

But the lack of detailed, clear-cut zoning means that a company cannot be entirely sure its application will be approved, at least in its original form. Given the great costs involved in buying land and doing design work, this lack of complete predictability is unnerving and means additional risks and possible delays in needed projects. It also means considerable additional cost is involved in applying for a permit, negotiating with government officials about possible changes, and making agreed-upon changes in either the design or even the location of the facility. And the more the companies distrust the government administering the performance standards, the more unnerved they will be .

In the final analysis, there appear to be one key fact and one main issue. The fact is that citizens, through their governments, want a larger say not only in the locating of energy facilities, but also in determining the need for them, evaluating the alternatives, and setting the specific conditions (e.g., environmental safeguards) under which they will be allowed. And in trying to develop new siting processes—especially a new government role—the country increasingly is using the "new" approach to siting, one that uses performance standards.

The issue is not only whether this new approach will "work"—and in many cases it is too soon to tell—but also whether anyone can devise a better way to accommodate all the relevant factors: the new activism of the public and the States, the need for new energy facilities, public and industry concern about added bureaucracy and paperwork, and industry's need for predictability and timely decisions.

The challenge now seems to be this: either implement and refine these new siting laws or else find workable alternatives to them. In any event, the siting procedures this country uses certainly will affect the course and timing of energy development in the coastal zone.

Nonfuel Mining on the Continental Shelf

Introduction

The waters and floor of the seas and the subsurface of the Continental Shelf are rich sources of minerals. In addition to fuels, quantities of barite, salt, and sulfur are produced from the U.S. continental shelf. Magnesium is extracted from seawater. Oyster shell, dredged from the inner margins of the continental shelf in the Gulf of Mexico, is a source of aggregates and lime.

There is a legal and administrative framework to govern exploration and development on the continental shelf. The Federal jurisdiction over the seabed and subsoil of the continental shelf has been established by treaties, Presidential proclamation, judicial decision, and Congressional action. The Submerged Lands Act of 1953 granted the coastal States title to submerged lands seaward from the ordinary low-water mark to a distance of 3 geographic miles. For Florida and Texas, jurisdiction extended up to 3 marine leagues (approximately 9 miles) into the Gulf of Mexico.

The Outer Continental Shelf Lands Act of 1953 gives the Secretary of the Interior discretionary authority to regulate mineral leasing on the part of the continental shelf lying seaward from the outer limits of the State grants.

Although there are few precedents in the administration of the Outer Continental Shelf Lands Act for mining hard minerals, the current leasing procedures have succeeded in developing offshore oil and gas resources. The States have complained, however, of a lack of coordination in the past. There is an attempt at coordination among the various Federal agencies having jurisdiction or responsibility for activities on the land and in the water of the Outer Continental Shelf. Development of marine resources affects navigation, commercial and sport fishing, research, recreation, esthetics, national defense, shipping, and the overall health of the marine environment.

The Army Corps of Engineers issues permits for structures in navigable waters of the Outer Continental Shelf. The Coast Guard has responsibility for safety at sea and on artificial islands or marine structures. The National Oceanic and Atmospheric Administration is concerned with fish, other marine life, and scientific investigation of the marine environment and the coastal zone. Other agencies have various responsibilities for activities on the shelf and the waters and air above.

---

186 U.S. Department of Commerce, Office of Coastal Zone Management. *State of California Coastal Management Program and Final Environmental Impact Statement.* Washington, D.C., August 1977, p. 158.

187 Attorney General of the State of California, "Combined Memorandum of Law in Support of Motion for Summary Judgment, and Opening Trial Brief of the California Coastal Commission, *American Petroleum Institute vs. Knecht,* pp. 12–13.

Extent and Distribution of the Resources

Three major classes of mineral resources are found on the continental margin: dissolved minerals in seawater, minerals in unconsolidated deposits that occur in a variety of locations from coastal beaches to the deep seabed, and minerals in consolidated deposits in bedrock.

Commodities in seawater are basically freshwater and minerals dissolved as salts, or in elemental form. Freshwater is also commonly found as submarine springs and constitutes a potential future source. The value of freshwater obtained from seawater in 1970 was estimated at $9.2 million.[188]

Unconsolidated deposits are defined as naturally occurring concentrations of minerals that are not hardened and are amenable to recovery by dredging. On the continental shelf (to water depths of 200 meters), unconsolidated deposits of major interest are nonmetallics, including sand and gravel, glass sands, lime shells and calcareous algae phosphorite, and aragonite; heavy minerals including alluvial tin, iron sands, and titanium sands; and native elements including gold, platinum and diamonds. On the continental slope (to depths of 2,000 meters) unconsolidated deposits of major interest include phosphorite, carbonaceous muds, and metalliferous muds.

Extraction of construction materials from offshore sources in 1973 constituted a $102.1 million industry, estimated to grow to $181 million in 1985; sand and gravel mining amounted to $65.6 million in 1973, and shell recovery and processing for use as an aggregate added another $36.5 million.[189]

Consolidated bedrock deposits of interest occur as surficial deposits of coral, barite, and phosphorite crusts and deeply buried deposits of coal, iron ore, sulfur, potash, and various metallic salts.[190]

Table 4–12 provides a classification of dissolved, unconsolidated, and consolidated resources that are known to be in the ocean. Detailed knowledge of marine deposits is very small. Only a small percentage of the continental margins and deep ocean basins has been surveyed for hard minerals. Before the full potential of these minerals can be realized, the technological and engineering capabilities to locate and assess them must be improved and applied. Based upon present geological understanding of the nature of the continental margins and deep seabeds, however, substantial deposits may be discovered.

Potential for Mining on the Continental Shelf

The potential for discovery and exploitation of marine hard minerals on the continental margin is high and the variety of deposit types is of the same order as that on land. Some marine mining operations on the continental margin are already economically viable, as indicated above, others are likely to be so within the next decade, both in deeper water and farther from land.

Minerals on the United States continental shelves that possess the potential for early economic development are the surficial deposits of sand, gravel, and calcium carbonate, placer deposits of titanium and gold, and marine phosphorite deposits. Based on geological and geophysical surveys performed by government and academic organizations in the past few years and the limited amount of industry information available, the National Academy of Sciences' Marine Board Panel on Operational Safety in Marine Mining concluded in 1975 that the following sites may have commercial mining potential within two decades:[191]

1. Gulf of Maine—potential for lode deposits, chiefly sulfides in shallow waters, and some potential for sand and heavy minerals.
2. Massachusetts Coast—parts of Cape Cod Bay and Buzzards Bay have good potential for sand, rare earth heavy minerals, and possibly coal.
3. New Jersey-New York Bight—known sand deposits.
4. Southeast Atlantic Coast—known beach resource of heavy mineral sands, but the sand potential of the seaward Outer Continental Shelf lands is incompletely known.
5. Gulf of Mexico—potential for hard minerals on the Outer Continental Shelf appears to be limited as a whole, although the U.S. Geological Survey has identified abundant black sands (including titanium-bearing minerals) off the Texas coast. Oyster shells may prove to be a resource on the Outer Continental Shelf in the

[188] U.S. Senate Committee on Commerce. *The Economic Value of Ocean Resources to the United States.* Robert R. Nathan Associates, Inc., Washington, D.C., Government Printing Office, 1974 p. 30.

[189] Ibid. p. 42.

[190] M. J. Cruickshank. "Mineral Resources Potential of Continental Margins," in *The Geology of Continental Margins,* edited by C. A. Burke and C. L. Drake. New York: Springer Verlag, 1974, pp. 965–1000.

[191] National Research Council, Panel on Operational Safety in Marine Mining, Marine Board, Assembly of Engineering. *Mining in the Outer Continental Shelf and in the Deep Ocean.* Washington, D.C., 1975, pp. 19–20.

Table 4–12.—Classification of marine mineral resources [1]

Marine mineral deposits	Unconsolidated			Consolidated
Dissolved	Continental Shelf 0–200 m	Continental Slope 200–3,500 m	Deep Sea 3,500–6,000 m	
Seawater:	*Nonmetallics:*	*Authigenics:*	*Authigenics:*	*Disseminated, massive, vein, tabular or stratified deposits of:*
Fresh water	Sand and gravel	Phosphorite	Ferromanganese nodules and assoc.	Coal
Metals and salts of:	Lime sands and shells	Ferromanganese oxides and assoc. minerals	Cobalt	Ironstone
Magnesium	Silica sand	Metalliferous mud with:	Nickel	Limestone
Sodium	Semiprecious stones	Zinc	Copper	Sulfur
Calcium	Industrial sands	Copper	*Sediments:*	Tin
Bromine	Phosphorite	Lead	Red clays	Gold
Potassium	Aragonite	Silver	Calcareous ooze	Metallic sulfides
Sulfur	Glauconite		Siliceous ooze	Metallic salts
Strontium	*Heavy minerals:*			Hydrocarbons
Boron	Magnetite			
Uranium	Hmenite			
Other elements	Rutile			
Metalliferous brines:	Monazite			
Concentrations of:	Chromite			
Zinc	Zircon			
Copper	Cassiterite			
Lead	*Rare and precious minerals:*			
Silver	Diamonds			
	Platinum			
	Gold			
	Native copper			

[1] Source: Section 20, Marine Mining, Michael J. Cruickshank and Ralph W. Marsden (eds.), in *SME Mining Engineering Handbook* (copyrighted by AIME), Volume 2, Arthur B. Cummins and Ivan A. Given (eds.). Society of Mining Engineers of The American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, N.Y., 1973, p. 20–24. Used by permission of AIME.

future. There is a possibility of finding economically attractive deposits of finely divided metal sulfides that were formed in place on the continental slope.

6. Southwest Pacific Coast—know deposits of sand, gravel, and phosphorite.
7. Northwest Pacific Coast—Outer Continental Shelf off northern California and Oregon is known to have modest placer deposits of gold and other heavy metals.
8. Great Lakes—although not Outer Continental Shelf lands, the portion of the lake beds within the United States are known to have manganese and copper ore deposits.
9. Bering Sea—Outer Continental Shelf has the most promising potential for mining and hard minerals of all U.S. Outer Continental Shelf waters. Placer deposits of this potential include: gold, platinum, cassiterite (tin), scheelite (tungsten), rare earths, ilmenite (titanium), and others. Lode deposits are likely to include barite and copper, lead and zinc (as sulfides), and molybdenum, while deposits of chemical precipitates of uranium-bearing minerals are probable in some anoxic sites. Government, industry, and academic groups have been making hard mineral surveys for more than 10 years.
10. Arctic Shelf—largely of unknown potential, but drainage from metal-bearing provenance rocks probably washes some noble metals into Outer Continental Shelf high-energy sand sites.
11. Insular States and Territories—although few mineral surveys have been made in the Outer Continental Shelf or its equivalent waters off American Samoa, Puerto Rico, Hawaii, or the Trust Territories, the potential for volcanic and basalt-related minerals and manganese crusts appears likely.

Environmental Impact and Conflict With Other Uses

Potential pollution from marine mining operations depends on both the mining methods and the specific environmental conditions of the operation. Generalizations based on either a commodity or a location by itself could be misleading. Apart from some broad guidelines, assessments of potential pollution from marine mining must be operation- and site-specific.

Potential environmental effects from production activities at sea are of three general types: alteration of the shape of the sea floor, interference with other uses of the area, and disturbance of marine ecosystems. The present use of trailing suction hopper dredges for sand and gravel mining, for example, causes a general lowering of the seabed over the area of the deposit to a maximum of about 5 meters. Stationary dredges as now used, mostly for sand, leave a hole in the seabed up to 20 meters deep and 80 meters in diameter. In both instances, there is a release of fine-grained solid materials into the water near the dredge, either from perturbation of the seabed by the dredgehead or from overflow of the hopper. The release of toxic substances into the water is not a general feature of sand and gravel dredging.

Dredging may change the shape of the seabed sufficiently to alter local wave and current patterns. This could lead to local changes in coastal erosion or deposition and could cause destruction of beaches, siltation of harbors, removal of offshore banks, or disruption of longshore sand transport systems within the immediate area. Such impacts as a result of mining on the Outer Continental Shelf are unlikely.

Experience in Europe and elsewhere has shown that mining operations can be hazardous to other marine activities or emplacements, causing collisions in shipping channels, disturbance of navigational buoys or anchorages, and cutting or displacing buried cables or pipelines. Fishing activities have been disturbed by the creation of obstructions to bottom trawls, particularly where deep pits have been excavated in fishing grounds or large boulders have been exposed by removal of the surrounding substrate. In some areas, illegal dredging has allegedly destroyed maricultural nursery grounds.

The potential impact of marine mining on ecosystems is the least known area of environmental problems, and without doubt, the most difficult one to assess. For the most part, effects are secondary and due to some alteration in the existing physical, chemical, or trophic equilibrium. Impacts on the coastal zone tend to be more significant than those on the Outer Continental Shelf because of the higher physical and biological energy levels generally recorded there and the proximity to population centers. Physical changes that may induce biological effects include variations in temperature, current patterns, amounts of suspended particulates present, nature of the sea floor and substrate, light penentration and photosynthesis, and the introduction of new habitats. Significant chemical changes may be caused by the presence of nutrients, trace elements, or toxics. Possible changes in the food chain include removal of, or influence on, existing species by involving them in the dredging operation. In general, alterations in temperature and chemistry are unlikely and would occur only as a result of induced changes in current patterns near shore, where there were very significant gradients of local temperature and chemicals.

Analyses of the potential impacts require a knowledge of the undisturbed populations and their natural cycles to that changes can be predicted, verified,

and controlled. At the present time, there is little agreement within the scientific community about what constitutes adequate knowledge of pre-operating conditions or baselines. Difficulties arise in the selection of indicator species that will adequately represent the biotic community and its reaction to the disurbances. The idea of measuring baselines is so new that the effect of long-term regional cycles, for which there are no data, cannot be determined. The effect of local impacts on regional or global communities may be underestimated.

From the foregoing considerations, it can be generally concluded that potential disturbances from marine mining operations depend on both the mining method and the environmental conditions of the area. Most physical and chemical changes can be measured, but assessing the effects of biological perturbations requires intensive and long-term study.[192]

State Approaches in Dealing With Offshore Mining

In the 3-mile territorial sea of the United States, the coastal States have been vested with ownership of mineral resources under the Submerged Lands Act of 1953. Accordingly, in this area, the offshore leasing statutes of such States govern. Most States have moratoriums or severe restrictions on mining in the coastal zone.

There is every indication that the mining of selected deposits on the Outer Continental Shelf, under the jurisdiction of the Federal Government, will occur in the future and will require extensive environmental monitoring and control and coordination with the coastal States.

---

[192] M. J. Cruickshank and H. D. Hess. "Marine Sand and Gravel Mining," *Oceanus, Journal of the Woods Hole Oceanographic Institution* 19:1, Fall 1975, 32–44.

Table 4–2. Population and economic characteristics of U.S. coastal counties, districts, and municipalities (continued)

Coastal State and locality	Population: Per unit	Population: Per sq. mi.	Population: Change 1960–70	Value added by manufacturing	Change 1963–67	Farmland	Change 1964–69	Local government revenue	Per capita outlay	Per capita income change 1969–74
			±%	*million dollars*	±%	*1,000 acres*	±%	*million dollars*	*dollars*	%
Alabama										
Baldwin	59,382	38	21.0	23.3	89.4	309	−4.1	7.2	116	57.7
Mobile	317,308	256	1.0	279.9	32.7	169	−23.5	69.1	163	58.8
Coastal area	376,690			303.2						58.2
Alaska										
Aleutian Islands	8,057	1	34.0	12.8	.0	1,161	−13.1	.0	0	81.0
Anchorage	124,542	136	.0	15.7	.0	299	−42.7	34.3	376	64.3
Angoon	463	0	.0	1.7	.0	0	.0	.0	0	143.8
Barrow	2,703	0	24.8	.0	.0	0	.0	.0	0	82.8
Bethel	7,579	0	40.3	.0	.0	0	.0	.0	0	109.7
Bristol Bay borough	1,045	2	.0	5.2	.0	0	.0	.5	0	82.2
Bristol Bay division	3,587	0	.0	1.5	.0	0	.0	.0	256	84.2
Cordova-McCarthy	1,774	0	5.6	3.4	.0	0	.0	.0	0	55.3
Haines	1,540	1	.0	.0	.0	0	.0	.0	0	38.6
Juneau	13,520	11	.0	1.2	.0	1	.0	5.7	484	68.5
Kenai-Cook inlet	14,250	1	133.7	6.6	.0	24	−68.0	.0	0	53.6
Ketchikan	10,041	7	.0	28.1	.0	0	.0	4.7	450	68.6
Kobuk	4,434	0	24.6	.0	.0	0	.0	.0	0	88.2
Kodiak	9,409	2	.0	9.3	.0	0	.0	2.4	278	71.0
Matanuska-Susitna	6,552	0	.0	.1	.0	0	.0	2.3	425	60.0
Nome	5,749	0	−5.6	.0	.0	0	.0	.0	0	86.0
Outer Ketchikan	1,755	0	.0	.0	.0	0	.0	.0	0	97.0
Prince Of Wales	2,027	1	18.8	.7	.0	0	.0	.0	0	109.8
Seward	2,021	1	−21.0	.4	.0	0	.0	.0	0	76.1
Sitka	6,424	3	.0	22.5	.0	0	.0	1.5	201	68.1
Skagway-Yakutat	2,021	0	.0	4.6	.0	0	.0	.0	0	67.0
Upper Yukon	1,666	0	4.0	.0	.0	0	.0	.0	0	55.8
Valdez-Chitina-Whittier	3,116	0	8.9	.0	.0	0	.0	.0	0	106.4
Wade Hampton	3,917	0	25.2	.0	.0	0	.0	.0	0	76.3
Wrangell-Petersburg	4,913	1	.0	13.0	.0	0	.0	.0	0	72.4
Coastal area	243,105			117.5						78.9
California										
Alameda	1,073,184	1,464	18.2	1,291.3	26.5	291	−6.1	472.6	381	44.3
Contra Costa	558,389	756	35.9	602.1	10.7	315	4.0	252.7	431	48.0
Del Norte	14,580	14	−18.0	22.2	7.2	35	−4.0	8.7	484	47.6
Humboldt	99,692	28	−5.0	117.0	.9	790	.4	48.1	425	46.5
Los Angeles	7,036,463	1,730	16.6	2,088.2	34.6	558	−4.7	2,980.1	356	36.7
Marin	206,038	398	40.8	57.1	136.0	175	1.2	81.0	361	49.1

Table 4–2. Population and economic characteristics of U.S. coastal counties, districts, and municipalities (continued)

Coastal State and locality	Population: Per unit	Population: Per sq. mi.	Population: Change 1960–70	Value added by manufacturing	Change 1963–67	Farmland	Change 1964–69	Local government revenue	Per capita outlay	Per capita income change 1969–74
			±%	*million dollars*	±%	*1,000 acres*	±%	*million dollars*	*dollars*	%
Mendocino	51,101	15	.1	52.1	18.4	946	−11.4	20.5	369	42.6
Monterey	250,071	74	24.8	130.5	83.8	1,472	−1.2	90.1	327	49.4
Napa	79,140	101	20.1	55.4	158.9	220	−16.4	27.3	324	40.9
Orange	1,420,386	1,817	101.8	1,963.8	63.9	184	−24.3	460.0	302	42.5
Sacramento	631,498	650	26.1	487.1	5.3	517	−9.0	277.4	371	44.9
San Diego	1,357,782	319	31.4	803.8	21.5	616	−11.5	465.5	320	43.1
San Francisco	715,674	15,904	−3.3	732.3	19.8	0	.0	464.5	423	41.5
San Joaquin	290,208	205	15.8	323.4	45.2	876	−9.1	148.6	454	49.5
San Luis Obispo	105,690	33	30.4	10.5	19.3	1,553	1.8	41.6	387	45.3
San Mateo	556,234	1,245	25.3	477.2	29.8	85	1.5	232.0	389	45.4
Santa Barbara	264,324	97	56.4	108.6	72.4	952	2.7	95.4	312	41.7
Santa Clara	1,064,714	821	66.1	1,907.5	57.6	480	4.8	426.4	388	45.8
Santa Cruz	123,790	281	47.0	76.8	22.7	61	−41.1	50.9	359	45.9
Solano	169,941	209	37.8	46.3	81.6	358	−6.0	62.8	309	48.2
Sonoma	204,885	128	39.0	79.7	50.9	667	−3.9	81.4	349	46.3
Ventura	376,430	203	90.1	160.5	106.0	433	−1.0	134.9	338	42.4
Coastal area	16,650,214			11,594.4						44.8
Connecticut										
Fairfield	792,814	1,266	21.3	1,885.9	47.3	23	−33.1	214.8	233	38.1
Middlesex	114,816	309	29.4	225.5	55.6	24	−42.3	23.4	198	38.4
New Haven	744,948	1,233	12.8	1,527.6	36.3	46	−20.6	183.3	212	37.9
New London	230,348	346	24.2	358.6	12.7	95	−21.5	47.6	179	43.2
Coastal area	1,882,926			3,297.6						39.4
Delaware										
Kent	81,892	138	24.7	163.4	246.9	220	−5.3	16.6	149	49.3
New Castle	385,856	881	25.5	619.7	28.2	113	−6.4	108.6	216	47.2
Sussex	80,353	85	9.8	175.2	37.2	341	−6.3	16.2	169	50.8
Coastal area	548,101			958.3						49.1
Florida										
Bay	75,283	101	12.1	37.0	17.8	22	−34.7	18.2	232	58.1
Brevard	230,006	228	106.4	310.7	813.8	228	19.5	60.2	232	36.7
Broward	620,069	509	85.7	196.2	152.2	61	−30.2	105.6	220	56.2
Charlotte	27,559	39	118.8	1.3	116.7	218	−20.2	3.5	144	57.7
Citrus	19,196	34	107.1	.7	−30.0	109	−7.6	3.9	222	49.1
Clay	32,059	54	64.1	10.1	90.6	156	−18.5	5.1	178	59.0
Collier	38,040	19	141.5	2.1	250.0	310	5.5	8.6	278	51.9
Dade	1,267,792	621	35.6	589.4	62.3	79	−32.3	341.7	247	57.0
De Soto	13,060	20	11.8	5.0	47.1	271	−8.2	2.5	149	54.2

Dixie	5,480	8	22.3	2.6	44.4	165	−19.3	1.6	264	58.7
Duval	528,865	690	16.1	331.2	37.5	74	−15.5	107.0	214	61.8
Escambia	205,334	309	18.1	.0	.0	108	−14.5	44.8	199	58.2
Flagler	4,454	9	−2.5	.0	.0	92	−37.8	2.4	284	71.8
Franklin	7,065	13	7.4	.6	−25.0	0	.0	1.6	184	63.5
Gulf	10,096	18	1.6	.0	.0	14	81.8	3.4	274	57.2
Hernando	17,004	35	51.8	1.5	200.0	84	−12.6	11.0	303	50.5
Hillsborough	490,265	472	23.2	367.9	41.6	375	−51.3	117.9	213	60.5
Indian River	35,992	71	42.2	25.5	200.0	189	−18.5	10.3	282	66.0
Jefferson	8,778	15	−8.0	1.0	42.9	162	−4.3	2.1	208	61.0
Lee	105,216	134	92.9	11.7	82.8	142	−12.1	23.3	207	47.8
Levy	12,756	12	23.1	3.3	175.0	310	4.1	2.6	175	50.6
Manatee	97,115	131	40.4	42.9	86.5	320	18.3	24.7	301	61.5
Martin	28,035	50	65.6	3.9	129.4	212	22.7	6.0	206	64.9
Monroe	52,586	51	9.7	4.9	96.0	0	.0	9.7	155	66.1
Nassau	20,626	32	20.0	41.5	23.1	65	−16.6	5.2	257	63.9
Okaloosa	88,187	93	44.2	19.1	516.1	76	−11.1	16.9	158	57.4
Palm Beach	348,753	173	53.0	236.3	69.8	527	17.6	107.9	263	60.3
Pasco	75,955	102	106.5	22.4	23.1	338	−6.0	7.2	126	61.8
Pinellas	522,329	1,971	39.4	191.5	33.2	21	−55.9	121.3	227	57.6
Putnam	36,290	47	13.1	.0	.0	278	−23.8	10.5	248	55.1
St. Johns	30,727	51	3.3	16.9	45.7	66	−32.8	7.2	190	52.1
St. Lucie	50,836	87	29.4	13.3	26.7	325	−4.1	12.4	290	62.1
Santa Rosa	37,741	37	27.7	.0	.0	108	8.6	7.2	194	55.8
Sarasota	120,413	205	56.6	28.1	8.5	149	−11.8	30.3	259	52.5
Taylor	13,641	13	3.6	28.3	38.0	106	−44.5	4.4	261	53.2
Volusia	169,487	160	35.2	70.2	22.9	223	−27.7	56.5	265	55.9
Wakulla	6,308	10	20.0	.7	−36.4	14	−34.2	1.5	193	55.8
Walton	16,987	15	3.3	2.6	73.3	147	19.5	3.5	203	58.3
Coastal area	5,469,485			2,906.4						57.4
Georgia										
Bryan	6,539	15	5.0	.7	−22.2	31	−11.5	1.3	178	62.7
Camden	11,334	17	13.6	.0	.0	47	−15.5	2.2	180	63.6
Chatham	187,767	422	−.3	247.1	15.6	25	−47.0	47.6	209	58.0
Glynn	50,373	123	20.4	90.5	−11.7	20	−56.3	13.0	230	59.0
Liberty	17,569	34	21.3	1.7	240.0	21	−69.9	2.2	140	59.7
McIntosh	7,371	17	15.8	4.5	1,025.0	7	−82.3	1.4	189	57.5
Coastal area	280,953			344.5						60.0
Hawaii										
Hawaii	63,468	16	3.5	34.4	−5.5	1,203	−12.7	15.3	183	53.6
Honolulu	629,176	1,058	26.0	252.2	40.8	147	−4.0	102.1	104	
Kauai	29,761	48	5.6	20.6	10.2	273	−3.8	7.6	234	59.5
Maui	46,156	39	7.7	19.0	−29.6	435	−18.1	13.3	224	58.2
Coastal area	768,561			326.2						57.1
Illinois										
Cook	5,488,328	5,759	7.1	1,640.0	29.3	93	−7.9	1,604.5	250	41.2
Lake	382,638	837	30.3	566.5	31.3	111	−6.0	89.4	211	44.3
Coastal area	5,870,966			2,206.9						42.7

Table 4–2. Population and economic characteristics of U.S. coastal counties, districts, and municipalities (continued)

Coastal State and locality	Population			Value added by manufacturing		Farmland		Local government revenue	Per capita outlay	Per capita income change
	Per unit	Per sq. mi.	Change 1960–70		Change 1963–67		Change 1964–69			1969–74
			±%	*million dollars*	±%	*1,000 acres*	±%	*million dollars*	*dollars*	%
Indiana										
Lake	546,253	1,065	6.4	1,698.4	6.5	168	−4.4	176.9	262	50.3
La Porte	105,342	174	10.8	224.6	53.9	293	5.8	24.9	196	46.1
Porter	87,114	205	44.5	108.2	101.9	175	−8.2	19.4	217	48.9
Coastal area	738,709			2,031.2						48.4
Louisiana										
Acadia	52,109	79	4.4	14.9	98.7	336	−3.9	9.7	169	60.2
Ascension	37,086	123	32.8	17.9	−52.0	64	−30.7	6.4	152	55.5
Assumption	19,654	55	9.2	8.6	−49.1	85	−3.5	3.3	139	70.7
Calcasieu	145,415	132	.0	183.8	22.4	403	−23.7	36.7	215	53.1
Cameron	8,194	6	18.6	3.8	.0	287	1.0	2.7	304	49.9
East Baton Rouge	285,167	621	24.0	455.3	24.6	134	−12.4	65.9	188	48.3
Iberia	57,397	97	11.1	20.2	29.5	131	−2.2	11.3	191	56.1
Iberville	30,746	49	2.7	.0	.0	122	−.8	7.5	188	58.6
Jefferson	337,568	917	62.0	243.7	68.5	9	−11.8	62.0	196	48.9
Jefferson Davis	29,554	45	−.9	5.5	266.7	366	2.7	7.7	230	58.9
Lafourche	68,941	60	24.5	21.4	.9	205	−9.1	15.1	192	56.2
Livingston	36,511	56	35.4	3.5	133.3	45	−35.5	6.5	175	53.7
Orleans	593,471	3,013	−5.4	464.2	26.6	0	.0	153.5	193	48.9
Plaquemines	25,225	24	11.9	20.5	33.1	32	−44.7	9.8	181	58.2
St. Bernard	51,185	100	59.0	137.1	42.8	7	−53.1	9.8	173	53.2
St. Charles	29,550	101	39.3	116.5	.0	34	−36.2	6.4	203	60.2
St. James	19,733	78	7.4	35.5	47.9	57	−8.2	4.4	218	67.9
St. John the Baptist	23,813	105	29.1	39.4	.0	23	−40.5	3.6	128	65.4
St. Martin	32,453	44	11.7	4.4	33.3	100	−8.2	4.8	130	64.9
St. Mary	60,752	97	24.4	52.6	70.8	121	−1.7	14.4	206	53.4
St. Tammany	63,585	72	64.5	15.2	39.4	80	−11.2	12.9	190	49.6
Tangipahoa	65,875	82	10.8	16.4	19.7	160	−19.0	11.7	163	51.7
Terrebonne	76,049	56	25.1	30.6	94.9	100	−18.9	15.4	190	54.8
Vermilion	43,071	36	10.9	12.8	103.2	393	1.6	10.2	202	63.0
West Baton Rouge	16,864	83	14.0	2.8	40.0	55	16.4	4.5	223	60.1
Coastal area	2,209,968			1,926.6						56.8
Maine										
Cumberland	192,528	219	5.3	219.6	45.9	67	−41.9	40.9	183	42.6
Hancock	34,590	23	7.1	25.1	52.1	47	−48.9	5.6	163	44.5
Knox	29,013	79	1.5	22.6	32.2	40	−52.3	5.0	163	48.2
Lincoln	20,537	45	11.0	9.0	40.6	32	−41.9	3.7	176	46.5
Sagadahoc	23,452	91	2.9	43.5	18.9	18	−52.7	4.0	132	39.4

Waldo	23,328	32	3.1	13.5	.0	99	−38.7	4.6	188	47.4
Washington	29,859	12	−9.3	23.7	12.3	83	−48.4	4.0	119	43.0
York	111,576	111	12.2	94.3	57.4	81	−39.4	19.0	155	42.3
Coastal area	464,883			451.3						44.2
Maryland										
Anne Arundel	297,539	705	44.2	225.9	18.6	63	−17.2	68.9	202	52.9
Baltimore	621,077	1,037	26.0	930.3	16.2	118	−11.6	159.9	210	49.0
Calvert	20,682	95	30.7	1.3	−23.5	62	−16.9	4.4	211	69.3
Caroline	19,781	62	1.6	14.1	8.5	133	−8.3	5.4	244	45.3
Cecil	53,291	147	10.1	40.8	38.3	114	−10.8	9.8	165	48.7
Charles	47,678	104	46.4	4.4	29.4	107	−16.0	9.1	213	61.0
Dorchester	29,405	50	−.9	39.4	63.5	140	−7.0	7.2	209	54.6
Harford	115,378	255	50.4	56.7	47.3	133	−12.1	21.8	179	50.7
Kent	16,146	57	4.3	6.9	7.8	148	1.8	3.3	210	49.1
Prince Georges	660,567	1,363	85.0	140.1	42.8	92	−19.1	144.8	211	50.8
Queen Annes	18,422	49	11.2	4.0	14.3	171	−4.0	5.0	247	56.6
St. Marys	47,388	127	21.8	2.0	5.3	95	−18.5	12.2	253	61.0
Somerset	18,924	56	−3.6	10.1	55.4	70	−11.3	4.0	178	51.8
Talbot	23,682	91	9.8	13.3	23.1	125	.0	5.0	172	50.4
Wicomico	54,236	142	10.6	66.8	38.3	113	−3.4	12.9	200	48.4
Worcester	24,442	51	3.0	30.0	39.5	128	−8.3	4.6	147	54.4
Baltimore City	905,759	11,613	−3.5	1,521.0	16.7	0	.0	371.9	324	
Coastal area	2,974,397			3,107.1						71.1
Massachusetts										
Barnstable	96,656	246	37.5	12.5	115.5	5	−49.7	34.9	383	42.5
Bristol	444,301	802	11.5	747.9	34.4	46	−20.1	115.2	244	39.9
Dukes	6,117	59	4.9	.0	.0	9	63.1	2.9	426	43.7
Essex	637,887	1,291	12.1	1,056.3	24.3	39	−19.7	186.6	267	41.8
Nantucket	3,774	82	6.0	.0	.0	0	.0	1.8	383	43.8
Norfolk	605,051	1,535	18.5	687.4	48.9	18	−22.7	181.1	268	39.2
Plymouth	333,314	510	34.2	201.2	34.4	79	−24.7	87.7	257	39.4
Suffolk	735,190	13,128	−7.1	1,241.0	26.2	0	−69.5	375.5	438	35.0
Coastal area	2,862,790			3,946.3						40.6
Michigan										
Alcona	7,113	10	12.0	1.5	.0	56	−24.8	1.7	207	40.4
Alger	8,568	9	−7.4	.0	.0	25	−22.1	2.6	257	46.5
Allegan	66,575	81	15.3	67.3	70.4	276	−4.1	15.2	199	45.9
Alpena	30,708	54	7.5	62.2	33.8	93	−22.0	11.6	321	45.1
Antrim	12,612	26	21.6	11.9	33.7	70	−28.1	3.6	289	38.3
Arenac	11,149	30	13.1	4.1	105.0	91	−9.2	2.9	258	48.8
Baraga	7,789	9	8.9	7.8	39.3	25	−27.8	2.9	323	45.3
Bay	117,339	263	9.6	189.7	54.1	185	−5.7	31.0	224	44.9
Benzie	8,593	27	9.7	6.8	112.5	39	−17.1	2.7	304	37.5
Berrien	163,875	283	9.4	363.9	36.7	216	−9.3	44.8	256	42.3
Charlevoix	16,541	40	23.2	23.3	70.1	51	−28.8	4.3	255	43.6
Cheboygan	16,573	23	13.9	9.6	159.5	55	−25.8	4.1	229	34.3
Chippewa	32,412	20	−.7	2.0	−66.7	96	−25.2	10.9	273	49.1
Delta	35,924	31	4.7	37.4	61.2	102	−13.3	8.7	241	47.9
Emmet	18,331	40	15.3	9.4	−22.3	57	−29.6	4.7	252	41.1

Table 4–2. Population and economic characteristics of U.S. coastal counties, districts, and municipalities (continued)

Coastal State and locality	Population			Value added by manufacturing	Change 1963–67	Farmland	Change 1964–69	Local government revenue	Per capita outlay	Per capita income change 1969–74
	Per unit	Per sq. mi.	Change 1960–70							
			±%	*million dollars*	±%	*1,000 acres*	±%	*million dollars*	*dollars*	%
Gogebic	20,676	19	−15.2	7.3	78.0	12	−34.9	7.2	312	46.9
Grand Traverse	39,175	85	17.0	31.8	55.9	84	−10.6	9.9	232	40.4
Houghton	34,652	34	−2.8	8.9	−3.3	46	−39.4	7.7	201	45.9
Huron	34,083	42	.2	24.0	63.3	426	−5.0	8.7	209	53.4
Iosco	24,905	46	50.9	6.7	19.6	74	−.7	6.0	221	46.1
Keweenaw	2,343	4	−6.3	.1	−83.3	0	.0	.6	219	58.8
Leelanau	10,872	32	16.6	2.0	66.7	78	−25.4	2.2	170	46.7
Lenawee	81,609	109	5.4	196.6	74.0	404	−3.1	21.5	237	39.7
Luce	6,789	7	−13.3	2.1	110.0	12	−31.9	2.4	255	40.1
Mackinac	9,660	10	−11.0	.4	−69.2	28	−4.0	3.0	267	43.7
Macomb	625,309	1,303	54.1	1,131.9	61.9	97	−28.6	159.6	239	42.2
Manistee	20,094	37	7.1	41.9	15.4	68	−13.8	5.1	223	42.0
Marquette	64,686	35	15.2	15.5	25.0	27	−34.7	16.8	213	49.4
Mason	22,612	46	3.1	31.9	13.5	96	−18.9	5.1	195	41.9
Menominee	24,587	24	−.4	26.2	26.6	162	−22.1	6.4	248	48.9
Monroe	118,479	214	17.9	121.0	24.0	254	−3.8	24.1	193	44.1
Muskegon	157,426	314	5.0	384.9	27.2	72	−20.5	46.7	249	42.3
Oceana	17,984	34	8.7	5.0	92.3	131	−13.4	4.5	188	40.7
Ontonagon	10,548	8	−.3	.0	.0	49	−19.0	3.4	267	47.8
Ottawa	128,181	228	29.8	227.2	41.1	177	−11.8	28.4	221	41.9
Presque Isle	12,836	20	−2.1	1.9	171.4	96	−26.6	3.3	230	49.5
St. Clair	120,175	164	12.1	165.1	42.2	218	−22.0	32.0	235	38.8
Sanilac	34,889	37	8.9	40.1	31.9	461	−11.1	9.0	226	42.5
Schoolcraft	8,226	7	−8.1	4.1	41.4	15	−18.0	3.0	307	48.8
Tuscola	48,603	60	12.2	31.4	48.1	359	−8.1	11.1	189	46.2
Van Buren	56,173	93	16.1	70.0	49.3	225	−6.7	16.1	246	42.8
Wayne	2,666,751	4,414	.2	5,908.8	20.1	50	−24.3	974.4	306	42.5
Coastal area	4,956,427			9,283.7						44.4
Minnesota										
Cook	3,423	3	1.4	1.0	11.1	0	.0	1.9	544	55.7
Lake	13,351	6	−2.6	2.0	42.9	7	−42.2	5.4	334	64.5
St. Louis	220,693	36	−4.7	114.0	3.4	181	−36.5	88.2	330	54.5
Coastal area	237,467			117.0						58.2
Mississippi										
Hancock	17,387	36	23.8	.0	.0	40	−36.6	2.8	104	52.9
Harrison	134,582	230	12.6	42.7	50.9	40	−16.5	26.0	154	43.9
Jackson	87,975	120	58.5	169.9	69.2	36	−35.5	17.5	184	54.7
Coastal area	239,944			212.6						53.8

New Hampshire										
Rockingham	138,951	201	40.3	68.0	63.9	57	−39.9	25.6	180	43.6
Strafford	70,431	187	17.8	117.8	27.8	39	−32.1	13.9	181	41.2
Coastal area	209,382			185.8						42.4
New Jersey										
Atlantic	175,043	308	8.8	150.1	53.2	31	−19.4	60.6	294	44.1
Bergen	898.012	3,834	15.0	1,469.4	26.4	6	2.9	237.9	242	42.9
Burlington	323,132	395	43.9	269.4	31.6	142	−13.8	68.1	195	45.8
Camden	456,291	2,065	16.4	590.5	20.1	12	−15.9	143.5	262	43.4
Cape May	59,554	223	22.7	13.9	16.8	16	−10.6	22.3	337	48.6
Cumberland	121,374	243	13.6	254.1	42.8	95	2.9	31.0	216	42.3
Essex	929,986	7,173	1.0	1,762.9	28.4	1	−7.7	365.3	357	40.1
Gloucester	172,681	525	28.1	192.3	5.0	74	−7.4	39.8	215	45.3
Hudson	609,266	12,933	−.5	1,584.9	14.4	0	66.7	190.9	277	41.2
Middlesex	583,813	1,871	34.6	1,472.5	37.1	33	−14.1	153.7	260	46.9
Monmouth	459,379	970	38.1	259.5	27.0	78	−12.0	123.7	262	43.9
Ocean	208,470	325	92.6	49.2	29.8	10	−50.2	52.8	275	43.2
Salem	60,346	165	2.8	185.5	−2.3	105	−5.0	18.1	255	47.8
Union	543,116	5,273	7.7	1,762.0	38.1	1	−18.2	156.1	257	42.6
Coastal area	5,600,463			10,016.4						44.1
New York										
Bronx	1,471,690	35,895	3.3	570.7	20 5	0	.0	.0	0	42.4
Cayuga	77,439	111	4.7	79.0	48.5	278	−9.9	31.6	411	40.4
Chautauqua	147,305	136	1.3	230.3	28.8	322	−18.3	56.8	329	39.6
Dutchess	222,295	273	26.3	281.8	83.0	162	−21.1	67.9	279	37.5
Erie	1,113,491	1,052	4.6	1,896.5	25.1	222	−17.4	406.1	326	40.2
Jefferson	88,508	68	.8	77.7	37.5	408	−15.9	39.8	365	35.5
Kings	2,602,012	37,172	−1.0	2,190.7	3.0	0	.0	.0	0	40.5
Monroe	711,917	1,055	21.4	2,709.0	66.2	156	−21.1	271.2	361	39.0
Nassau	1,428,075	4,944	9.9	1,639.8	44.8	2	−56.2	664.8	417	38.5
New York	1,539,233	66,923	−9.4	5,666.8	20.7	0	.0	4,866.8	479	21.0
Niagara	235,720	443	−2.7	756.9	37.0	172	−5.2	99.1	365	38.4
Orange	221,657	266	20.6	168.3	24.5	157	−22.2	74.4	308	39.0
Orleans	37,305	94	9.2	47.3	73.3	166	.3	13.1	321	39.7
Putnam	56,696	245	78.7	13.7	45.7	14	−36.8	18.5	363	38.1
Queens	1,986,473	18,400	9.8	1,680.7	18.6	0	−85.6	.0	0	32.5
Richmond	295,443	5,094	33.1	136.7	4.8	0	.0	.0	0	44.3
Rockland	229,903	1,306	68.1	371.9	44.6	4	−10.7	77.7	356	40.8
St. Lawrence	111,991	41	1.0	143.7	16.5	543	−18.2	44.9	351	40.0
Suffolk	1,124,950	1,213	69.0	589.9	37.3	62	−17.2	412.5	377	40.1
Wayne	79,404	131	16.8	89.4	23.8	229	−4.8	31.0	324	43.0
Westchester	894,104	2,019	10.6	956.3	26.6	15	−18.5	393.8	387	34.7
Coastal area	14,675,611			20,207.7						58.1
North Carolina										
Beaufort	35,980	44	−.1	28.6	130.6	196	−10.8	8.5	204	61.2
Bertie	20,528	29	−15.7	8.1	88.4	194	1.3	4.7	175	81.3
Brunswick	24,223	28	19.5	5.4	−15.6	87	−13.1	3.5	170	63.4
Camden	5,453	23	−2.6	.1	.0	56	3.9	.9	151	72.4
Carteret	31,603	59	15.2	8.7	50.0	31	−24.5	6.1	133	54.5

Table 4–2. Population and economic characteristics of U.S. coastal counties, districts, and municipalities (continued)

Coastal State and locality	Population: Per unit	Population: Per sq. mi.	Population: Change 1960–70	Value added by manufacturing	1963–67 Change	Farmland	Change 1964–69	Local government revenue	Per capita outlay	Per capita income change 1969–74
			±%	*million dollars*	±%	*1,000 acres*	±%	*million dollars*	*dollars*	%
Chowan	10,764	62	−8.2	13.1	351.7	59	3.3	2.3	150	60.1
Craven	62,554	89	6.4	17.8	24.5	113	−10.7	10.8	157	63.6
Currituck	6,976	28	5.7	.1	−66.7	53	−24.4	1.1	141	55.9
Dare	6,995	18	17.9	.0	.0	0	.0	1.5	189	54.3
Gates	8,524	25	−7.9	1.6	128.6	86	−4.0	1.7	147	76.2
Hertford	23,529	67	3.6	13.0	49.4	105	8.4	4.0	159	66.4
Hyde	5,571	9	−3.4	.6	50.0	79	3.8	.9	149	73.3
New Hanover	82,996	449	15.7	80.3	117.6	18	13.6	20.2	217	58.4
Onslow	103,126	135	19.6	3.3	135.7	97	−13.1	9.7	76	66.6
Pamlico	9,467	28	−3.9	.8	.0	45	−19.9	1.3	134	67.9
Pasquotank	26,824	118	4.7	7.8	−46.6	68	−8.0	6.4	211	65.5
Pender	18,149	21	−1.9	2.5	56.3	112	−14.5	3.1	172	70.6
Perquimans	8,351	34	−9.0	1.8	157.1	81	−10.4	1.7	179	78.3
Tyrrell	3,806	10	−15.8	.0	.0	34	−16.1	1.0	229	71.5
Washington	14,038	41	4.1	.0	.0	91	29.8	2.6	164	69.1
Coastal area	509,457			193.6						66.5
Ohio										
Ashtabula	98,237	140	5.8	174.5	55.1	192	−10.5	22.1	201	41.4
Cuyahoga	1,721,300	3,774	4.4	3,911.7	24.8	10	−38.7	509.6	246	41.1
Erie	75,909	288	11.6	160.7	29.7	107	−2.1	17.5	194	42.8
Lake	197,200	854	32.6	273.0	65.3	21	−39.3	52.2	237	41.8
Lorain	256,843	519	18.1	533.8	−1.4	162	−12.3	60.2	199	45.5
Lucas	484,370	1,410	5.8	942.0	32.0	99	−5.5	136.6	244	42.8
Ottawa	37,099	142	5.0	44.2	−17.2	130	1.8	8.1	190	47.2
Sandusky	60,983	149	8.0	136.8	49.5	241	3.2	13.4	190	47.1
Wood	89,722	145	23.6	137.8	38.2	371	9.9	17.0	197	47.2
Coastal area	3,021,663			6,314.5						44.1
Oregon										
Clatsop	28,473	35	4.0	36.1	38.3	24	−39.9	10.0	337	46.0
Columbia	28,790	45	28.6	32.5	1.9	74	−21.6	8.9	240	55.7
Coos	56,515	35	2.8	79.8	15.3	197	−20.8	17.7	266	45.6
Curry	13,006	8	−7.0	22.2	−.4	91	−17.4	5.7	342	50.3
Douglas	71,743	14	4.8	103.5	24.2	464	−12.1	26.6	273	47.9
Lane	213,358	47	32.2	208.2	13.4	271	−35.0	61.9	244	46.3
Lincoln	25,755	26	4.5	17.7	−26.9	47	−30.7	9.6	266	54.4
Tillamook	17,922	16	−4.9	19.8	46.7	51	−23.4	6.0	315	50.3
Coastal area	455,562			519.8						49.5

Pennsylvania										
Delaware	600,035	3,270	8.8	1,018.0	90.0	11	−32.1	108.0	166	41.8
Erie	263,654	324	5.2	575.1	38.9	218	−16.7	55.3	184	49.0
Philadelphia	1,948,609	15,116	−2.6	3,269.9	17.7	3	−12.0	590.9	248	43.5
Coastal area	2,812,298			4,863.0						44.7
Rhode Island										
Bristol	45,937	1,837	23.7	66.0	47.0	3	−17.4	9.9	205	48.8
Kent	142,382	823	26.4	147.5	48.1	6	−52.0	25.3	180	47.5
Newport	94,559	819	15.1	39.3	189.0	12	−35.8	17.5	174	53.4
Providence	580,261	1,398	2.2	1,020.2	32.4	25	−30.4	128.2	188	43.5
Washington	85,706	267	45.1	78.0	160.0	23	−31.2	15.3	179	51.7
Coastal area	948,845			1,351.0						48.9
South Carolina										
Beaufort	51,136	88	15.7	2.5	78.6	83	−14.7	5.9	110	80.3
Berkeley	56,199	51	47.1	8.3	9.2	100	−33.3	6.7	125	60.5
Charleston	247,650	264	14.5	138.9	41.2	71	−26.5	38.7	125	55.3
Colleton	27,622	26	−.7	12.2	60.5	259	−16.5	4.8	148	59.4
Georgetown	33,500	41	−3.7	53.9	11.8	68	−46.5	5.1	139	65.6
Horry	69,992	61	2.6	13.6	28.3	271	−16.1	9.4	116	64.8
Jasper	11,885	18	−2.9	2.3	21.1	102	−30.5	1.8	137	64.4
Williamsburg	34,243	37	−16.3	25.5	64.5	291	−8.5	5.5	129	67.2
Coastal area	532,227			257.2						64.6
Texas										
Aransas	8,902	32	27.1	.0	.0	51	−1.4	1.8	184	58.1
Brazoria	108,312	76	42.1	474.9	71.4	599	−14.2	27.9	245	59.5
Calhoun	17,831	34	7.5	.0	.0	208	27.9	6.9	279	65.9
Cameron	140,368	157	−7.1	61.6	65.6	452	6.1	31.1	173	51.5
Chambers	12,187	20	17.4	.0	.0	359	3.4	4.3	297	58.3
Galveston	169,812	426	21.0	497.7	45.5	130	7.4	47.6	248	51.1
Harris	1,741,912	1,011	40.1	2,324.1	46.1	551	−2.0	367.1	193	54.3
Jackson	12,975	15	−7.6	.0	.0	506	−3.2	3.3	199	63.0
Jefferson	244,817	259	.3	988.7	83.5	350	−14.3	68.4	218	57.6
Kenedy	752	0	−23.3	.0	.0	545	2.2	.2	153	59.3
Kleberg	33,166	39	10.4	1.9	280.0	935	1.4	6.6	177	52.2
Matagorda	27,913	24	8.4	20.7	256.9	600	−6.6	9.2	254	61.3
Nueces	237,544	282	7.2	.0	.0	486	−25.1	66.8	236	50.0
Orange	71,226	198	17.9	177.7	7.8	75	−27.2	37.2	237	55.4
Refugio	9,494	12	−13.5	.1	.0	393	−30.8	4.0	288	51.1
San Patricio	47,288	69	5.0	.0	.0	435	−19.9	9.9	181	56.8
Victoria	53,766	60	15.7	52.7	.0	474	−19.6	14.3	225	61.5
Wharton	36,729	34	−3.7	8.1	68.8	701	−.7	11.0	252	64.3
Willacy	15,570	26	−22.5	.3	−40.0	377	−.4	3.7	168	48.1
Coastal area	2,990,564			4,608.5						56.8
Vermont										
Franklin	31,282	47	6.1	29.9	43.8	256	−15.3	4.3	135	39.4
Grand Isle	3,574	43	22.1	.0	.0	31	−20.0	.8	190	40.2
Coastal area	34,856			29.9						39.8

Table 4–2. Population and economic characteristics of U.S. coastal counties, districts, and municipalities (continued)

Coastal State and locality	Population: Per unit	Population: Per sq. mi.	Population: Change 1960–70	Value added by manufacturing	1963–67 Change	Farmland	Change 1964–69	Local government revenue	Per capita outlay	Per capita income change 1969–74
			±%	*million dollars*	±%	*1,000 acres*	±%	*million dollars*	*dollars*	%
Virginia										
Accomack	29,004	61	−5.3	5.8	18.4	105	−8.0	5.1	129	67.4
Caroline	13,925	26	9.4	3.5	45.8	85	−13.9	2.1	132	65.4
Charles City	6,158	34	12.1	.2	−33.3	25	−33.3	1.0	159	70.4
Chesterfield	76,855	174	8.2	155.9	46.7	32	−44.0	16.0	134	53.8
Essex	7,099	28	6.1	7.7	140.6	72	−9.8	1.0	145	63.0
Gloucester	14,059	62	18.0	2.9	45.0	35	−21.7	1.9	120	56.4
Hanover	37,479	81	36.0	7.6	26.7	142	−2.1	3.9	93	58.6
Henrico	154,364	674	31.6	31.3	49.8	40	−18.8	25.4	155	59.2
Isle of Wight	18,285	58	6.5	63.3	45.2	102	−1.8	3.0	135	63.0
James City	17,853	117	54.7	.0	.0	21	−19.8	2.0	105	56.6
King and Queen	5,491	17	−6.8	1.3	.0	55	−21.1	.8	100	69.4
King George	8,039	46	11.0	.0	.0	40	−8.6	.9	107	52.1
King William	7,497	27	−.9	.0	.0	61	−23.6	1.1	107	59.1
Lancaster	9,126	67	−.5	2.8	−30.0	26	14.4	1.1	118	63.4
Mathews	7,168	81	.7	.3	200.0	11	7.2	.9	114	50.7
Middlesex	6,295	48	−.4	1.5	50.0	26	−11.0	1.1	138	74.5
New Kent	5,300	25	17.7	1.1	.0	30	−10.6	.7	129	76.3
Northampton	14,442	66	−14.9	7.3	17.7	51	−20.1	2.6	136	68.2
Northumberland	9,239	49	−9.3	4.9	75.0	50	−5.2	1.2	113	72.8
Prince George	29,092	105	43.5	.0	.0	66	−11.7	2.8	88	74.9
Richmond	5,841	34	2.0	3.8	.0	47	−29.5	1.1	146	65.6
Spotsylvania	16,424	40	18.9	.0	.0	72	−24.7	2.3	124	57.0
Stafford	24,587	91	45.7	.7	−22.2	36	−22.7	2.8	109	61.2
Surry	5,882	21	−5.4	.0	.0	72	2.1	.7	106	75.5
Westmoreland	12,142	53	10.0	2.3	53.3	65	−11.8	2.1	157	73.3
York	33,203	257	53.8	.0	.0	11	8.3	5.5	149	59.6
Chesapeake City	89,580	263	21.6	28.4	9.2	69	−11.4	21.1	216	
Colonial Heights City	15,097	1,887	57.5	2.3	27.8	0	.0	2.4	145	
Hopewell City	23,471	2,608	31.2	105.5	7.4	0	.0	6.6	260	
Newport News City	138,177	2,003	21.6	219.8	18.4	0	.0	28.6	170	
Norfolk City	307,951	5,810	1.0	158.5	7.1	0	.0	93.4	275	
Petersburg City	36,103	4,513	−1.8	146.4	52.3	0	.0	12.3	267	
Portsmouth City	110,963	3,826	−3.3	40.8	67.9	0	.0	24.6	210	
Richmond Ctiy	249,621	4,157	13.4	3.8	.0	0	.0	69.3	276	
Virginia Beach City	172,106	665	102.0	3.8	216.7	52	−16.7	24.7	158	
Coastal area	1,717,918			836.4						64.1
Washington										
Clallam	34,770	20	15.8	44.4	2.8	36	−43.7	12.4	320	46.1
Grays Harbor	59,553	31	9.3	109.9	32.6	59	−31.5	16.9	257	46.5

Island	27,011	127	37.5	.8	14.3	19	−45.7	4.7	178	46.1
Jefferson	10,661	6	10.6	.0	.0	15	−29.5	3.4	319	43.0
King	1,156,633	545	24.0	1,932.4	44.0	61	−25.8	345.5	271	40.8
Kitsap	101,732	259	20.9	11.2	53.4	24	−51.9	22.1	207	42.4
Mason	20,918	22	28.7	.0	.0	27	−26.4	4.7	245	48.8
Pacific	15,796	17	7.6	11.3	16.5	39	−21.3	4.7	301	50.2
Pierce	411,027	245	27.8	282.6	43.5	73	−44.7	105.7	247	46.0
San Juan	3,856	22	34.3	.3	−25.0	26	−32.0	1.0	283	41.6
Skagit	52,381	30	2.0	101.9	41.3	117	−14.3	18.5	291	47.7
Snohomish	265,236	126	54.0	106.1	−23.4	95	−26.1	59.6	229	42.9
Thurston	76,894	108	39.7	56.0	34.3	81	−37.3	17.1	232	43.6
Wahkiakum	3,592	14	4.8	.0	.0	21	−24.2	.9	249	53.3
Whatcom	81,950	39	16.5	107.5	68.8	142	−19.9	19.3	217	48.5
Coastal area	2,390,626			2,914.1						45.8
Wisconsin										
Ashland	16,743	16	−3.6	16.1	69.5	80	−27.3	5.2	291	48.7
Bayfield	11,683	8	−1.9	11.7	160.0	105	−34.0	4.4	320	45.0
Brown	158,244	302	26.5	282.4	51.7	256	−8.8	39.4	234	49.8
Burnett	9,276	11	.7	4.1	70.8	109	−26.1	3.1	303	47.0
Door	20,106	41	−2.8	15.6	108.0	178	−18.6	6.8	272	46.5
Douglas	44,657	34	−.8	23.6	7.3	79	−29.7	15.6	314	48.4
Iron	6,533	9	−16.6	2.6	136.4	18	−33.4	2.7	399	42.7
Kenosha	117,917	434	17.2	209.8	−42.3	109	−4.8	34.0	255	57.3
Kewaunee	18,961	57	3.7	20.1	54.6	192	−4.7	6.0	270	49.9
Manitowoc	82,294	139	9.4	147.0	35.1	304	−3.6	23.4	260	47.8
Marinette	35,810	26	3.3	72.0	41.7	189	−20.3	12.4	315	47.9
Menominee	2,607	7	.0	2.4	.0	0	.0	1.5	480	73.3
Milwaukee	1,054,063	4,448	1.8	2,464.6	21.4	17	−32.3	422.0	312	47.8
Oconto	25,553	26	2.8	22.0	6.3	272	−12.3	6.3	209	47.7
Ozaukee	54,421	231	41.7	106.6	70.0	105	−2.9	14.3	258	51.0
Racine	170,838	507	20.5	425.0	50.9	140	−5.8	47.1	255	51.6
Sheboygan	96,660	191	11.8	203.3	42.0	239	−10.3	27.7	251	43.3
Coastal area	1,926,366			4,028.9						49.7

Chapter V: Marine Transportation

Introduction

Transportation has traditionally been a major arena for Government regulatory and developmental activity. The vital importance of safe, efficient transportation to economic well-being and security has long been recognized and because of the large expenditures required to build and maintain many elements of a viable transportation system, substantial Government involvement has been a natural development.

In water transportation, an early role for Government evolved in developing and maintaining the water transportation infrastructure. Traditional Government activities in this area have included assistance in port and waterway development projects, the promulgation and enforcement of standards for the safe operation of the water transport system, and the provision of services to aid navigation and safety.

In recent years a growing Government role has emerged in conjunction with efforts to better integrate requirements for efficient water transportation with other broad social objectives such as environmental protection, public safety, and better management of limited ocean and coastal resources.

Another traditional area of Government involvement in water transportation has been in the development and implementation of shipping policies. Such policies have been defined as actions taken by government to modify the impact of market forces on the construction and operation of merchant vessels.[1] These measures, which include both regulatory and promotional activities, may be temporary or may be carried out over an extended period and may range from relatively subtle or indirect actions intended to exert minor or peripheral influence on the market, to outright state ownership and operation of shipping and shipbuilding assets. Under this broad definition, few maritime nations today would be correctly characterized as having no shipping policy. While the extent and nature of Government involvement varies widely from one maritime nation to another, some degree of Government participation in maritime affairs is now probably almost universal among maritime states.[2]

In the United States, Government participation in the development and regulation of water transportation, and in the promotion of U.S. shipping and shipbuilding, dates from the earliest days of the Republic. The second and third acts of the First Congress established lower import and tonnage duties for U.S. vessels than for foreign vessels,[3] and 5 of the first 11 acts of the First Congress contained provisions to regulate shipping and encourage the growth of the American merchant marine. Early articulation of the importance of navigation to both our commerce and defense was contained in a letter written in 1793 by Thomas Jefferson to the House of Representatives.[4]

> "As a branch of industry [our navigation] is valuable, but as a resource of defense, essential. Its value as a branch of industry is enhanced by the dependence of so many other branches on it. In times of general peace it multiplies competitors for employment in transportation, and so keeps that at its proper level, and in times of war—that is to say, when those nations, who may be our principal carriers, shall be at war with each other—if we have not within ourselves the means of transportation, our produce must be exported in belligerent vessels, at the increased expense of war freight and insurance, and the articles which will not bear that must perish on our hands. But it is as a resource of defense that our navigation will admit neither neglect nor forebearance. The position and circumstances of the United States leave them nothing to fear on their landboard, and nothing to desire beyond

[1] S. G. Sturmey. "National Shipping Policies," *Journal of Industrial Economics*, 13: 14–29, November 1965.

[2] Even "flag-of-convenience" governments (such as Liberia) exert some influence over the operation of merchant vessels under their registry, although effective regulation is characteristically minimal. Growing pressure for better control of vessels under convenience registry is gradually compelling many of these nations to adopt increasingly stronger merchant shipping policies.

[3] Gerald R. Jantscher. *Bread Upon the Waters: Federal Aids to the Maritime Industries*, Washington, D.C., The Brookings Institution, 1975, p. 1.

[4] Thomas Jefferson, 1793 letter to the U.S. House of Representatives, as quoted in a speech delivered on March 25, 1922, by Joseph E. Ransdell of Louisiana before the Senate of the United States.

> their present rights. But on their seaboard they are open to injury, and they have there, too, a commerce which must be protected. This can only be done by possessing a respectable body of citizen seamen and of artisans and establishments in readiness for shipbuilding."

This expression of the essentiality of a reliable merchant marine to the commercial and security interests of the Nation has been a dominant theme throughout the history of U.S. maritime policy.

Although the new U.S. Government took immediate steps to promote, protect, and regulate U.S. shipping and shipbuilding, most early government assistance in support of port and waterway development in the United States was provided by State and local governmental units. However, by the early 1800s serious consideration was being given to the idea that the Federal Government should assume a primary role in developing a national transportation system.[5] In 1808, Albert Gallatin, Secretary of the Treasury, proposed that the Federal Government undertake a comprehensive program of highway and waterway development to promote economic expansion and provide needed communication links between populated areas. Although this concept received considerable support, and led to the construction of the Cumberland Road, most early waterway and highway projects remained the exclusive province of State and local governments.

Despite the central role of State and local aid in this period, two important Federal programs were initiated which have persisted in various forms throughout our history. In 1790, the Revenue Marine (a predecessor of the Coast Guard) was established as a Federal maritime law enforcement agency, and in 1824 the Army Civil Works Program was begun in order to provide technical assistance in developing a national waterway system through the Army Corps of Engineers. Although these activities have changed substantially over the years, the conceptual foundation for at least partial Federal responsibility for water transportation regulation and development was firmly established by these early actions. As is the case with other modes of U.S. transportation, the water transport system is characterized by a general sharing of responsibility among private interests and State, local, and Federal governmental entities.

Another important general characteristic of the U.S. water transportation system is the prominence of ocean shipping as a major component of both our domestic and international trade systems. Although it is the ocean component of the U.S. water transportation system which will be the focus of this study, it should be emphasized that this does not preclude consideration of domestic water carriage. Today coastwise, intercoastal, and noncontiguous domestic ocean commerce accounts for about one-fourth of all tonnage conveyed by water in the U.S. domestic trade. Furthermore, this domestic ocean movement is about one-third the size of total U.S. foreign trade. It is evident, therefore, that Government policies relating to the transportation uses of the sea affect not only our foreign trade transportation system, but domestic transportation as well. Conversely, both foreign and domestic trade considerations must be included in the development and implementation of U.S. ocean transportation policies.

Various dimensions of Federal ocean transportation policy are examined in the following sections. For this assessment, the body of U.S. policy relating to ocean transportation is divided into three broad categories of Government activity. The first section examines Federal infrastructure policies, including activities relating to port and harbor development, aids to navigation and safety, and activities designed to improve the compatibility of water transportation with other national objectives. The second section reviews the economic regulation of ocean shipping, including an examination of both domestic and foreign trade regulatory activities. Finally, promotion of U.S. shipping and shipbuilding is analyzed. This last section assesses both direct and indirect Government promotional activities. Each section includes a consideration of the background and major justifications for Government involvement, an assessment of current policy, and a description of the present policymaking system. In addition, a brief discussion of some of the major contemporary policy issues in each area is included.

The Marine Transportation Infrastructure

Government participation in the development and maintenance of the marine transportation infrastructure was a natural and early development in the United States. The importance of efficient transportation to economic expansion and communication, together with the large investments associated with port and harbor development, led inevitably to a substantial Government role in this area. The related need to assure safe, reliable operation of the water transport system compelled early Government participation in the development of standard navigation procedures, the provision of navigation aids, and the imposition of marine safety requirements.

[5] Dudley F. Pegrum. *Transportation Economics and Public Policy*, 3rd ed. Homewood, Ill.: Richard D. Irwin, 1973, p. 67.

Today three general policy objectives provide broad direction to most Federal governmental activities relating to the marine transportation infrastructure. First, Federal programs are intended to foster the development and maintenance of a safe, efficient, and reliable marine transportation system that can satisfy U.S. foreign and domestic trade requirements and meet marine transportation demands in time of war or other national emergency. Second, Federal programs have been traditionally designed to minimize interference with private, State, and local water transporation prerogatives and to impact without regional discrimination. Finally, the increasing concern for environmental protection has led to a variety of initiatives designed to minimize the adverse impact of the marine transportation system on the natural environment and to assure that full consideration is given to competing demands for the use of ocean and coastal resources.

It is evident, of course, that these three general objectives may frequently conflict, necessitating some form of equitable compromise. As a consequence, an overriding Federal function in this area today must be to resolve these conflicts fairly by assuring that all three objectives receive full and systematic consideration in the formulation and execution of marine transportation policy.

Ports and Harbors[6]

The Federal policy of nondiscrimination with respect to U.S. port development finds its origins in Article 1, Section 9 of the Constitution, which provides, in part, that: "No preference shall be given by any regulation of commerce on revenue to the ports of one State over those of another . . ." This nondiscrimination provision reflects two interrelated views which have dominated Federal port policy throughout our history. First, it arises from the underlying philosophy that Federal involvement in waterway development and regulation should be kept to a minimum—a philosophy consistent with prevailing views in early America relating to the importance of imposing strict limits on the powers of Government in all areas. Second, this provision reflects the related view that whenever it is found necessary for the Federal Government to undertake any developmental or regulatory activity affecting ports, the economic impact of that activity should be geographically uniform so as not to provide one State or area with any economic advantage over another. As major determinants of Federal port policy, these two perspectives have significantly influenced the nature of port and harbor development in the United States.

The other major consideration which has shaped U.S. port policy has been a consistent recognition of the interrelationships between transportation, economic development, and national security. As noted in the Introduction, the importance of efficient transportation to economic well-being and security has long been recognized, and throughout our history the port and waterway programs administered by the Federal Government have been justified in terms of their contributions to economic development and national security. The security imperative is, of course, reflected in the early placement of transportation civil works responsibilities in the Department of the Army.

On the one hand, then, considerations of economic development and security have provided the major justifications for Federal participation in port and waterway development, while the general policy of nondiscrimination and the philosophy of minimal Federal interference have tended to temper and limit the scope of this Federal activity. It is within this philosophical environment that the current port policy system has emerged.

For the most part, Federal developmental activities have been confined to dredging and general harbor and waterway improvement projects designed to expand and improve the overall navigability of the U.S. port and waterway system. Individual projects have been evaluated, using fairly consistent criteria established by the Congress and applied on a case-by-case basis. Proposed projects have been required to be found economically feasible before final authorization. Traditionally, the Corps of Engineers has engaged in approved channel and harbor dredging projects without cost to port and waterway interests.

With respect to shoreside port development, the philosophy of minimal Federal involvement has prevailed. Although some Federal planning and developmental assistance is provided and although certain Federal regulatory functions are performed, operation and development of shoreside facilities, such as docks and warehouses, are activities which, by and large, have been left to private, State, and local interests.

The net effect of this division of port development responsibility has been the evolution of a port system responsive primarily to local economic imperatives rather than aggregate regional or national planning considerations and physically characterized by fairly uniform vessel draft constraints. Supporters of

[6] Henry S. Marcus et al. *Federal Port Policy in the United States*, Washington, D.C., U.S. Department of Transportation, June 1977. Much of the material contained in this section was derived from this recently published source. This study, sponsored by the Department of Transportation, presents a detailed and comprehensive assessment of current U.S. port policy and its origins.

the current U.S. port policy system have cited this division of responsibility and the local focus in shoreside development as fundamental to the maintenance of a flexible water transportation system which is responsive to rapidly changing U.S. trade requirements and local economic development considerations. Some critics, on the other hand, have suggested that the fragmented nature of the U.S. port policy system tends to impede aggregate efficiency owing to the inadequacy of planning based on broad regional and national considerations. The dispute between these two competing philosophical perspectives is likely to frame much of the debate over many of the more specific port policy issues in the future.

As indicated, U.S. shoreside port facilities are, for the most part, maintained and operated by a variety of private interests and State and local government entities. Today more than 60 percent of the 2,400 commercial marine terminals in the United States (terminals capable of accommodating U.S. foreign trade) are owned by private profit-making organizations. Except for a very few facilities owned by private nonprofit organizations and nonmilitary Federal agencies, the rest are owned and operated by either State (12 percent) or local (24 percent) governmental agencies.[7]

As a rule, private terminals are an integral part of some larger corporate activity and are generally designed to handle a single bulk commodity. Today bulk cargoes such as fuels, agricultural products, and ores account for about 95 percent of the total tonnage of cargo moving in U.S. waterborne commerce, and most of this traffic is handled by private port facilities. The State and local public terminals, on the other hand, are characteristically general cargo facilities which are operated on a "common carrier" basis. These facilities, in addition to seeking a return on investment, are commonly operated by governments in support of other general objectives relating to community economic development. Because of the substantial local economic benefit associated with a successful port, considerable community support and pressure for port development and expansion have been common.

Generally, public ports in the United States are operated by government port authorities of one kind or another. These institutions take many forms and may be part of an existing city, county, or State government or may be essentially autonomous local, State, or regional instrumentalities. While the form of this governmental institution varies widely throughout the United States, a common function is to improve port financing prospects through government involvement. Improved financing is in turn intended to yield better facilities, more trade and an expanded local economy.

Historically, the fragmented structure of the U.S. port policy system and the Federal policy of nondiscrimination did not present any major problems for U.S. port development and trade. Although at times there may have been a tendency toward the development of some excess capacity, port development costs were not great and, in general, capacity matched growing trade requirements fairly well.

In recent years, however, the system has experienced increasing pressure because of advances in shipping technology and because of growing environmental concerns. For many years, the relatively slow growth in vessel size, the prominence of comparatively small vessels, and the importance of breakbulk general cargo handling techniques fit well with a U.S. port system comprised of a national network of ports, each serving its own local economic community and each of sufficient depth to accommodate most commercial carriers. The absence of concern over such issues as spoil disposal and coastal zone management allowed port expansion and channel dredging to keep pace with the slow growth in vessel size and to proceed strictly in response to commercial requirements. The combination of a relatively simple shipping technology and the absence of requirements to incorporate environmental considerations tended to keep internal port development costs relatively low.

The introduction of containerization and other intermodal shipping services together with the explosive increase in average vessel size in recent years has spawned new concerns, however, that have raised questions regarding the adequacy of traditional U.S. port policies to meet contemporary trade requirements efficiently. The need for larger facilities to accommodate larger vessels and the extensive shoreside investment required to support intermodal shipping have resulted in dramatic increases in the cost of port development. To support these investments, individual ports have made efforts to expand the flow of cargo through their facilities, frequently seeking an enlargement of the economic community served by the port. This expansion, of course, has been facilitated by the availability of the intermodal cargo handling procedures that, in part, made it necessary.

While it has been suggested that the economies of scale inherent in modern intermodal cargo handling procedures may call for a reduction in the total number of ports needed, the local economic importance of maintaining a healthy port facility imposes strong pressures on each port in the system to seek intermodal traffic. There is concern, however, that these individual efforts may have resulted in the development of excess intermodal capacity in the total U.S. port system. But while some observers see this capacity as excess, others assert that most of the capacity identified by critics as redundant is

[7] Ibid., p. 7.

in fact essential to meet peak requirements and to assure system flexibility. In a 1976 report prepared by the National Research Council, the following conclusions were reached with respect to the issue of excess port capacity: [8]

> "The panel has concluded that it cannot quantitatively determine the existence of redundancy. Redundancy implies excess capacity, and it is impossible to provide an adequate measure for the capacity of a port. There are many reasons for this measurement problem: One is that the nature of cargo ships and productivity of facilities will vary greatly through time. Cargoes are not uniform. Peaking—the concentration of demand during limited periods of time—occurs in port operations as in all other aspects of transportation. It is [un]economical and, in some instances, physically impossible to provide for the maximum peaks. At the same time, it is undesirable that undue waiting time, leading to costly delays to vessels and cargo, occur because of the failure to provide for periodic peaks. Such delays, if common, could result in traffic being diverted to competing ports or, in some instances, not moving at all.
>
> Excess capacity, in one sense, does not exist even though a port or terminal may have 100 percent utilization of its capacity for only short periods of time, if ever. Consideration of peak activities, other than for very infrequent occasions, is an important element of port planning. Capacity must be supplied in order to provide adequate service to the shipping public as well as to anticipate possible national emergencies, when even the largest ports may be crowded.
>
> Another important reason, in the judgment of the panel, for providing capacity in excess of normal demands is to create competition among the various ports and port services to the advantage of the shipping public. That is, the public can be reasonably assured not only of continued availability of port services in the event of accidents or other closures or reductions but also of competitive rates and services. Thus, the shipper receives a series of options that would not be available unless interport competition continued."

The technological developments associated with the use of larger merchant vessels and intermodal cargo handling procedures have raised fundamental questions regarding the appropriateness and viability of the Federal port policy of nondiscrimination. Rising dredging costs, associated with strict new spoil disposal requirements, and increasing support for better planning based on regional and national trade requirements have lessened support for strict adherence to this traditional policy. While port interests generally favor a continuation of the traditional Federal role, there is clearly growing support for a stronger, more central Federal position with respect to U.S. port development. This support arises from increasing recognition of the need to give better voice to regional and national trade considerations in seeking a more efficient port system, the need to manage limited port development resources more carefully, and the need to assure full consideration of demands for competing uses of the coastal zone.

Although the Army Corps of Engineers historically has played the most prominent Federal role in the U.S. port development, more than 50 Federal entities have been identified as having some impact on or responsibility for port development or regulation today.[9] Hence, while Government port-related responsibilities are fragmented among levels of Government, they are also fragmented at the Federal level among various agencies.

In most cases, of course, the port-related activities of these agencies are carried out as a component or auxiliary feature of some other program directed toward objectives not necessarily related to port development. For example, port and harbor development projects supported by the Economic Development Administration of the Department of Commerce are undertaken principally to help local communities reduce unemployment. However, port- and harbor-related projects constitute a significant portion of total EDA public works expenditures and, therefore, represent a significant aid to water transportation development even though such development is not the primary motivation for Federal involvement. From the beginning of fiscal year 1966 through the end of fiscal year 1976, for example, EDA obligated almost $125 million for port and harbor public works projects.[10] This represents more than 6 percent of total EDA public works obligations over the period.

Of the 50 or so Federal organizations having some port-related responsibilities, only four are considered major participants in U.S. port development. While other agencies may influence port development through their programs, these four carry out activ-

[8] National Academy of Sciences, National Research Council, Maritime Transportation Research Board, Panel on Future Port Requirements of the United States. *Port Development in the United States*. Washington, D.C., National Academy of Sciences, 1976, p. 128.

[9] Henry S. Marcus, op. cit. note 6, p. 40.

[10] U.S. Department of Commerce, Economic Development Administration. 1976 Annual Report, Washington, D.C., March 25, 1977, p. 34.

ities specifically designed to aid and improve U.S. water transportation. The four are: the Army Corps of Engineers, the Maritime Administration, the Coast Guard, and the Department of Transportation. The port-related activities of three of these agencies will be briefly discussed in the rest of this section, while those of the Coast Guard will be deferred until the next section where they will be included along with an examination of other Coast Guard activities relating to marine navigation and safety. A later section will consider the marine environmental and coastal zone management functions of the Federal Government, which today also significantly influence U.S. port planning and development.

Historically, aid provided through Corps of Engineers dredging activities and port and harbor technical assistance programs has represented, by far, the largest component of Federal support to U.S. port development. Beginning with the transportation public works responsibilities conveyed in 1824, the central role of the Corps of Engineers in the development of the U.S. water navigation system has been consistently reaffirmed by the Congress in various river and harbor statutes. Over the years, these statutes have, in turn, modified and expanded the scope of the water navigation authority of the Corps in response to changing transportation requirements.

In addition, other statutes have greatly enlarged other Corps responsibilities with respect to general water resource management and development. As a consequence, water navigation development and improvement today is but one part of a multi-faceted Corps of Engineers water resource program which derives its authority from an array of Federal statutes. In fiscal year 1976, more than one-third of the $588 million obligated for general operations and maintenance was provided in support activities other than those related to navigation. And in the construction account, only about 20 percent of the more than $1.2 billion obligated in fiscal year 1976 was specifically earmarked for navigation projects.[11] In addition to its water navigation activities, the Corps today carries out major water-related programs in such diverse areas as hydroelectric power generation, flood control, recreation, control of shore and beach erosion, hurricane protection, and preservation and improvement of water quality.

Although its responsibilities for general water resource management have been vastly expanded over the years, the central role of the Corps of Engineers in providing Federal aid to water navigation development has not diminished as a consequence. Water navigation development projects sponsored by this agency continue to dominate Federal support to port and harbor development as they have in the past, despite declines in the percentage of total Corps resources committed to this activity. According to its 1975 annual report, since the navigation program began in 1824, ". . . the Corps has participated in the construction of 25,000 miles of inland and intercoastal waterways, 107 commercial port facilities, 400 small boat harbors, and 261 locks."[12] These statistics provide evidence of the preeminent historic role played by the Corps in U.S. water navigation development. The size of the fiscal year 1976 navigation obligation cited previously provides evidence that this role continues.

Most of the water resource responsibilities of the Corps, including most navigation activities, are carried out directly by Corps personnel at the local level. As a consequence, the Corps maintains an extensive field organization of 11 divisions with a total of 36 districts. The field structure is organized geographically by river basins and major drainage systems. Managed under the Directorate of Civil Works, this organization has about 300 military officers and 30,000 civilian employees.[13]

A recent major controversial issue relating to projects proposed by the Corps of Engineers and other water resource agencies has centered on the adequacy of the cost/benefit assessment made prior to proceeding with a new water development project. Specifically this controversy pertains to the selection of an appropriate discount rate for evaluating the present value of the stream of future benefits expected from a particular water navigation project. Essentially, the objective of the cost/benefit procedure is to assure selection of the best projects and to assure a yield on water resource projects at least equal to the yield which could be expected if the same resources were devoted to a secure long-term investment.

In October 1973, a major discount rate confrontation arose with the publication by the Water Resources Council of its *Principles and Standards for Planning*. Established by the Water Resources Planning Act of 1965 as an independent, interagency executive organization, comprised of various Cabinet-level officials,[14] the Water Resources Council

[11] U.S. Executive Office of the President, Office of Management and Budget. *The Budget of the United States Government—Appendix (Fiscal Year 1978)*, Washington, D.C., Government Printing Office, 1977, p. 385. These figures, no doubt, somewhat understate the actual size of the total navigation program since the navigation components of programs identified as multipurpose are not separately quantified in the budget.

[12] U.S. Department of the Army, Corps of Engineers. *1975 Annual Report of the Chief of Engineers on Civil Works Activities*. Washington, D.C., Corps of Engineers, February 1, 1977, p. 4.

[13] Ibid., p. 5.

[14] Council members include Secretaries of Agriculture, Army, Commerce, Interior, Housing and Urban Development, and Transportation; Administrator of Environmental Protection Agency; and Chairman of Federal Power Commission. Other agencies that participate in the activities of the Council when requested include Office of Management and Budget, Department of Justice, Council on Environmental Quality, and four regional River Basin Commissions.

experienced numerous early delays in instituting its strategic water resource planning function. Charged by the 1965 Act with responsibility for establishing, with the approval of the President, principles and standards for the formulation and evaluation of Federal water resource projects, the Council was unable to carry out this responsibility until 1973. In finally publishing its principles and standards, however, the Council, by imposing a substantially higher discount rate for evaluating water projects than the one used by the Corps of Engineers (and other water resource agencies), found itself in the midst of the discount rate controversy. While the prevailing rate established under the former procedure was 5⅜ percent, the Council established a new rate of 6⅞ percent, which seriously jeopardized many water projects that could not meet the more stringent economic criteria.

As a result of the Council action, immediate pressures were brought to bear in support of Congressional relief. Within 5 months the Congress enacted the Water Resources Development Act of 1974, which set the discount rate at about its former level. Following this action, the Council acceded to the Congressional mandate and set its discount rate at the level established by the Congress.

Although the immediate conflict regarding the discount rate was resolved by the Water Resources Development Act of 1974, the underlying controversy remains. The 1974 Act, in Section 80, called upon the President to undertake a thorough study of U.S. water resource projects, including an assessment of the discount rate issue. Although completed, the study has not been released, and the traditional procedure for evaluating projects has continued to be used in the absence of new criteria.

As a major factor influencing the selection of water development projects to be supported by the Federal Government, the discount rate issue is likely to continue to be a major point of debate in future considerations regarding all aspects of water resource development. In turn, the water navigation programs administered by the Corps of Engineers, including the port and harbor development program, will be significantly influenced by the resolution of this issue in years to come.

The second major Federal agency influencing U.S. port development is the Maritime Administration (MarAd), which is generally responsible for the promotion of the U.S. merchant marine and related elements of the U.S. water transportation system. Through its Office of Port and Intermodal Development, MarAd carries out a variety of advisory and promotional functions relating to U.S. port development. In general, these activities are intended to improve the efficiency and minimize the cost of the U.S. transportation system through improved ports and port facilities. The basic statutory authority for these activities is contained in Section 8 of the Merchant Marine Act of 1920 which provides that:

> ". . . it shall be the duty of the board [now the Maritime Administration], in cooperation with the Secretary of War, [now the Secretary of Defense], with the object of promoting, encouraging, and developing ports and transportation facilities in connection with water commerce over which it has jurisdiction, to investigate territorial regions and zones tributary to such ports, taking into consideration the economies of transportation by rail, water, and highway and the natural direction of the flow of commerce; to investigate the causes of the congestion of commerce at ports and the remedies applicable thereto; to investigate the subject of water terminals, including the necessary docks, warehouses, apparatus, equipment, and appliances in connection therewith, with a view to devising and suggesting the types most appropriate for different locations and for the most expeditious and economical transfer or interchange of passengers or property between carriers by water and carriers by rail; to advise with communities regarding the appropriate location and plan of construction of wharves, piers, and water terminals; to investigate the practicability and advantages of harbor, river, and port improvements in connection with foreign and coastwise trade; and to investigate any other matter that may tend to promote and encourage the use by vessels of ports adequate to care for the freight which would naturally pass through such ports . . ."

Essentially, the MarAd program is oriented toward providing regional planning aid and technical assistance and information in pursuing its legislative mandate in support of improved U.S. port efficiency. Consequently, the size of the staff and other resources devoted to this activity is relatively small. In total, only about 35 positions in both the headquarters and field offices are assigned to this program.

In support of the MarAd port program, the Office of Port and Intermodal Development helps the port industry assess port requirements and plan the development of ports and port facilities. This is accomplished through cooperative studies of port development in a number of States and on a national basis. This effort is also carried out through port development and shipper conferences. By 1980, the Office of Port and Intermodal Development expects to have identified the future port requirements of 33 of the

40 coastal and inland States having access to waterborne transportation.

The Office of Port and Intermodal Development also serves as a central clearinghouse for domestic and foreign port data and develops and promulgates statistical and economic information relating to the U.S. port system. Under the Defense Production Act of 1950 and Executive Order 11490 this office is responsible for port mobilization planning to assure the effective use of port facilities in time of war or other national emergency. Finally, through its field activities, the Office of Port and Intermodal Development provides special technical assistance to the Economic Development Administration in evaluating and planning EDA public works grants for port and harbor development, and to the National Oceanic and Atmospheric Administration on port-related matters pertaining to NOAA's coastal zone management program.

Although a fairly small, low-key program, MarAd port activities provide all members of the U.S. port policy system with important information and planning assistance that derive from a national marine transportation system perspective. As indicated previously, critics have suggested that this larger view has been too often absent in the evolution of the U.S. port system.

The role of the Department of Transportation (DOT) in the Federal port policy system is of relatively recent origin and is still evolving in many respects. Although the Coast Guard within DOT plays a major role in the areas of marine navigation, safety, and pollution abatement, the Department itself has, since its establishment in 1967, been only peripherally involved in water transportation policy. Under Section 7(a) of the Department of Transportation Act, DOT is specifically forbidden to undertake economic assessments of proposals for Federal funding of water resource projects and, in general, DOT has maintained a relatively low profile in the entire water transport area. Nonetheless, in light of its broad mandate to encourage an efficient national multimodal transportation system, some water transportation involvement has been inevitable and, in certain areas, a major DOT role may now be emerging.

At the broadest policy level, DOT has recently assumed a leadership role in attempting to analyze comprehensively the total U.S. transportation system and to establish national transportation policies based on a systematic consideration of total transportation requirements and the ability of each of the various transportation modes to fulfill these requirements. In September 1975, the Department issued *A Statement of National Transportation Policy,* which represented a first attempt to ". . . set forth the broad policy considerations that *should* underlie the Federal Government's response to the Nation's transportation needs." [15] [Emphasis added.] In that document full consideration was given to both domestic and international water transportation as major components of the total U.S. transportation system.

In January 1977, the Department released a comprehensive assessment of the entire U.S. foreign and domestic transportation system, projecting system development to the year 2000 under existing policies.[16] The objective of the study was to provide an inventory of transportation resources and to focus attention on the current direction of transportation development. The study was an effort to identify areas where it might be necessary or desirable to adopt alternative Federal policies which would yield a better transportation system in the years ahead. Again, in this effort full consideration was given to water transportation and it was again emphasized, as it was in the policy statement, that, although major elements of the Federal water transportation policy system lie outside DOT, it is imperative that port and waterway policies be consistent with overall national transportation policies.[17] The fragmented character of Federal port policy was specifically addressed, and support was indicated for a comprehensive national port study to be jointly supported by the Maritime Administration, the Corps of Engineers, and the Department of Transportation.[18]

This broad national transportation policy perspective has also provided the vehicle for a major DOT role in recent considerations of the issue of waterway user charges. The imposition of such user charges has, for many years, been urged by water-competitive modes which are prominent DOT constituents. These interests have long felt that water transportation enjoys an undue competitive advantage over competing modes because of the free use of Government-built and maintained waterway facilities. In addition, the growing cost of Federal waterway projects has increased pressure within the Government to impose some form of user charge to help defray these expenses.

In general, DOT has been a proponent of the concept of waterway user charges and, for that matter, a proponent of user charges for many Federally-provided transportation services and facilities. The Department has, however, recognized that in some cases it may be desirable, in support of other national objectives, to provide certain transportation services and facilities free or below cost. The De-

[15] U.S. Department of Transportation, Office of the Secretary. *A Statement of National Transportation Policy.* Washington, D.C., Government Printing Office, September 17, 1975, p. i.

[16] U.S. Department of Transportation, Office of the Secretary. *National Transportation Trends and Choices.* Washington, D.C., Government Printing Office, January 12, 1977.

[17] Ibid., p. 285.

[18] Ibid., p. 283.

partment position with respect to such subsidies was summarized in its 1975 policy statement: [19]

> (1) Federal subsidies are necessary in certain instances to serve important national purposes. These include conservation of energy, protection of the environment, preserving the urban centers, relieving congestion in certain high density corridors, promoting rational land use in metropolitan areas, preventing ultimate nationalization of a vital service and maintaining access to remote areas;
>
> (2) Even when it has been determined that Federal subsidies are really necessary, they should be periodically reexamined;
>
> (3) *Wherever possible the costs of Federal support should be recovered by user charges;* [Emphasis added.]
>
> (4) The effect of subsidies on competing modes should be considered and where there is an adverse effect the preference should be to reduce or eliminate the subsidy or adjust the user charges so that all users pay their full share;
>
> (5) There should be a preference for capital rather than operating subsidies; however, (a) care must be taken that capital subsidies do not induce excessive investment, [and] (b) where State and local governments are involved in the decision-making and operation, they should bear a share of the total cost sufficient to ensure commitment to efficient management; and
>
> (6) Where the political process determines that a subsidy is essential to the national interest because a particular form of transportation serves these interests more effectively, we should be prepared to take the next step in order to get the full benefit of the subsidy. This involves compatible adjustments in the Federal support of competing modes. We should not be inconsistent by continuing to subsidize competing modes, thereby diverting traffic away from the preferred mode and decreasing its chances of economic self-sufficiency.

Although water carriers have vigorously opposed the concept of user charges in the past, it now appears that at least some limited Federal tax on commercial waterway users is likely in the near future. In exchange for support for funding the reconstruction of Locks and Dam 26, which has been a major impediment to the free flow of water traffic on the upper Mississippi, water carrier groups have recently agreed to support a limited waterway user charge bill. Under the terms of H.R. 8309 a 4-cent per gallon fuel tax on commercial traffic using 26 specified inland waterways would be imposed beginning October 1, 1979. The tax would rise to 6 cents per gallon in 1981. Although small in size and limited in scope, this program would constitute a major breakthrough for waterway user charge proponents and would further the general transportation user charge philosophy advanced by DOT.

The growing role of DOT in U.S. port policy also arises from activities relating to intermodal facilitation. Developments in unitized and containerized cargo handling procedures have significantly affected not only water carriers, but land-based rail and truck operations as well. As the link between land and water modes, the port figures prominently in the successful and efficient operation of both. With major responsibilities relating to both rail and highway transportation, DOT has a natural interest in assuring that ports do not unduly constrain the flow of commerce between modes.

In addition, new land transportation opportunities (which have arisen from the ability to carry containerized cargo over new routes using a combination of land and water modes), have drawn the Department into the controversies relating to the so-called "landbridge" services which have emerged in recent years. Using container cargo handling procedures, new land/water services have been developed which have tended to alter traditional trading patterns. Ports which have lost traditional cargo to these new services have protested to the Federal Maritime Commission, arguing that allowing such services violates the principle of nondiscrimination among ports and that the rates being charged for portions of the service are not fully compensatory. Since its modal constituents have a definite stake in the outcome and because of its broad objective to improve U.S. transportation efficiency, DOT has been actively involved in these proceedings which have raised fundamental U.S. port policy issues. The "landbridge" issue will be considered again when specific attention is directed to Federal economic regulation of the U.S. water transport system.

A final major role in port development was added to the Department's responsibilities with enactment of the Deepwater Port Act of 1974. After considerable Congressional debate as to which Federal agencies should license and regulate offshore deepwater ports, it was decided that the licensing authority would be vested in DOT and the task of regulating operations delegated to the Coast Guard. (Ports

[19] U.S. Department of Transportation, op. cit. note 15, pp. 19–20.

within 3 miles of shore remain within the licensing authority of the Corps of Engineers.) In assessing applications for deepwater port facilities, DOT is required to give full consideration to their effect on other competing terminal facilities. Because of this requirement an expanded capability for general port analysis will have to be developed within DOT.

In the next section, Federal aids to navigation and safety will be discussed with principal emphasis on programs administered by the Coast Guard. The fourth major Federal agency with programs that substantially influence the development and operation of the U.S. port system, the Coast Guard is responsible for navigation, safety, and law enforcement activities that extend to all elements of the marine transportation infrastructure.

Aids to Navigation and Safety

A central Federal role in aiding and regulating navigation operations emerged early in the history of the United States. Although the central function of the original Revenue Marine (the organization established in 1790 and the principal predecessor of the Coast Guard) was to police the collection of tariffs and duties, other early Federal initiatives were undertaken related to the provision of navigation aids, vessel safety, and lifesaving. Ultimately these functions and others were integrated into the single multimission Coast Guard.

Even before the Revenue Marine was established, legislation had been passed creating a U.S. Lighthouse Service to coordinate and maintain a national system of marine navigational aids. Before the establishment of the Lighthouse Service in 1789, such aids were maintained separately by various ports and individual States in support of their own trade and commerce. Under the 1789 law the Federal Government offered to assume responsibility for the operation of such facilities, and soon all U.S. lighthouses had been transferred to this new Federal authority.

Although not a legally specified function in the beginning, the Revenue Marine played an important informal role from its inception in rendering aid to vessels in distress. Frequently in this early period, Revenue Cutters figured prominently in ocean rescue operations. In 1836 this role was formalized when public vessels were specifically directed to render aid to persons imperiled at sea, and in 1843 this responsibility was expanded to include the preservation of cargoes and property. Hence, a function performed informally in the early years grew quickly into one of the major formal responsibilities of the Revenue Marine and its successors.

The shore-based lifesaving operations of the Federal Government date from 1848 when an amendment to a lighthouse appropriation bill was enacted which provided for ". . . surfboats, rockers, carronades . . ." and other equipment to be used by volunteers along the New Jersey coast. Soon the system spread to New York, and in 1854 paid stationkeepers were authorized. In 1871 the Congress appropriated funds for surfmen, and, in 1897, the U.S. Life-Saving Service was formally organized as a separate agency within the Treasury Department.

With conversion from sail to steam as a major marine power source in the 19th Century, a Federal role in assuring vessel safety began to emerge. In the early period of conversion, explosions were so common on steam-powered vessels that demands soon developed for some form of Federal regulation. In 1838, Congress responded by passing a law requiring periodic hull and machinery inspection for all passenger-carrying steam-powered vessels. In addition, requirements relating to lifeboats, firefighting equipment, and other safety equipment were also imposed on such vessels. Before steamboats were legally authorized to carry passengers, they were required to obtain certificates of compliance with these safety standards. To carry out the provisions of this law, inspectors were appointed by U.S. district judges.

In 1852 a new law established a Steamboat Inspection Service and imposed further Federal standards for passenger-carrying steam-powered vessels. In addition, requirements were included for the licensing of steamboat pilots and engineers and operating rules to govern vessel passing situations were imposed. In 1871, vessel safety requirements were expanded to cover non-passenger carrying vessels, and licensing requirements were extended to masters and chief mates.

Soon after its establishment a major military responsibility also accrued to the Revenue Marine, and the mixture of civil and military tasks became a central characteristic of the service. With the dissolution of the remnants of the Revolutionary Navy just before the establishment of the Revenue Marine, it was natural for the new service to assume at least an interim naval function until a new Navy could be constituted. Resistance to the establishment and maintenance of a national naval military force was strong among Congressional representatives of southern and inland districts, and it was not until 1794, after a long and bitter debate, that a naval construction bill was finally passed. By this time the value of the Revenue Marine as an important military component of naval preparedness had been established and the dual military/civilian role of the service was retained. This mixture of military and civilian responsibilities has been a consistent feature of the Revenue Marine and the organizations that followed. Today the Coast Guard is considered one of the

Armed Forces of the United States and, when directed by the President during wartime, it is transferred in total from its peacetime location in the Department of Transportation to the Department of Defense.

Over the years the various lifesaving, navigation, and vessel inspection functions of the Federal Government have been carried out by various organizational units. At one point in the 1840s the aggregation of many of these functions under the Revenue Marine within the Department of the Treasury yielded an organization similar in scope to the modern Coast Guard. This structure, however, did not last, and the organizational shuffling of these functions continued into the 20th century.

In 1907, a Presidential commission on Government reorganization was established and subsequently recommended the abolition of the Revenue Marine with the transfer of its remaining functions to the Navy. The Congressional debate that followed the commission report ultimately led instead to the establishment, in 1915, of a new agency amalgamating the responsibilities of the Revenue Marine and the Lifesaving Service. This new agency was the Coast Guard.

Since its establishment in 1915, other Federal water transportation infrastructure activities relating to law enforcement, navigation, and safety have been steadily added to the Coast Guard mission. In 1936, the police powers of the Coast Guard were expanded to include the general enforcement of all Federal law relating to the U.S. navigable waters and the high seas. In 1939, the Lighthouse Service was transferred to the Coast Guard, establishing the Coast Guard as the central Federal agency responsible for the provision of aids to navigation. Finally, in 1942 the functions of the Bureau of Marine Inspection and Navigation (the successor to the Steamboat Inspection Service) were temporarily transferred to the Coast Guard and that transfer, too, was made permanent in 1946.

Thus, by the end of World War II all of the basic major powers and functions of today's Coast Guard were in place and its role as the central Federal actor with respect to marine navigation and safety had been established. Final recognition of the major transportation role of the Coast Guard and its diminished role in revenue collection came in 1967 when the agency was transferred from the Department of the Treasury to the newly-established Department of Transportation.

The major civil responsibilities of the Coast Guard today may be categorized into five general functional areas. First, most of its operating units maintain a capability for carrying out search and rescue operations on and over the high seas and waters subject to U.S. jurisdiction. This capacity is used by the Coast Guard to aid and rescue persons and protect property placed in jeopardy because of marine or aviation accidents or because of adverse environmental circumstances such as floods or ice conditions.

Second, a system of manned and unmanned aids to water navigation is maintained throughout the United States and LORAN stations are operated both in the United States and abroad to serve the needs of the armed services and of marine and air commerce. Additionally, administrative control is exercised over bridges across navigable waters to ensure that such structures do not interfere unduly with the safe operation of the U.S. water transport system.

The third major civil responsibility is in the area of marine safety where the Coast Guard is responsible for preventing maritime accidents and protecting life and property in U.S. waters and on the high seas. This is accomplished through the enforcement of U.S. laws and international agreements and through the development and enforcement of regulations and standards governing commercial and recreational vessels and U.S. ports and waterways. Compliance with Federal rules and statutes is assured through a program which includes the review of plans and specifications for the construction or alteration of merchant vessels, periodic inspection of vessels and marine facilities, licensing activities, management of vessel traffic, regulation of hazardous materials, and the establishment of standards for licensing and regulating marine personnel. Included in this area is an extensive safety program for recreational boating.

The fourth major Coast Guard function relates to ocean operations performed as part of the general law enforcement responsibilities of the agency and in support of other general national ocean activities. Under this program, Coast Guard cutters and aircraft maintain patrols to enforce international agreements and U.S. laws on the high seas and in waters under U.S. jurisdiction, perform ice patrol and icebreaking operations, and support marine science operations on a cooperative basis with other agencies. Enforcement of the new 200-mile U.S. fishing limit is one of the activities conducted in this general area of responsibility.

Finally, a major Coast Guard function that has expanded rapidly in recent years has been marine environmental protection. Largely an outgrowth of its general responsibility for enforcing Federal maritime laws, this activity today has become a major Coast Guard mission in itself. Under various statutes, the Coast Guard is charged with responsibility for carrying out programs to prevent damage to the marine environment and to improve overall environmental quality. Related activities to secure and protect U.S. ports and waterways are conducted to improve the economic use of the U.S. water transporta-

tion system and assure its availability in time of national emergency.

In support of its multifaceted mission, the Coast Guard maintains an extensive field operation throughout the United States and abroad that includes more than 630 manned operational and support facilities. Total operating assets today include 247 cutters ranging in length from 65 to 378 feet, 7 icebreakers, 1,950 boats of less than 65 feet, and 175 fixed and rotary wing aircraft. The agency employs 37,300 military personnel and 6,500 civilians.

The operating units of the Coast Guard fully reflect the multimission character of the parent agency. Although an individual operating unit may be charged with a primary responsibility in the area of search and rescue, law enforcement, aids-to-navigation, or other specific program area, each facility also routinely supports other Coast Guard missions. For example, Marine Safety Offices have been established to coordinate related functions of the Marine Environmental Protection, Commercial Vessel Safety, and Port Safety and Security Programs. A fisheries patrol unit must also be responsive to search and rescue emergencies and must be prepared to render assistance in the event of a pollution incident. Application of the multimission concept to the training of personnel and the design and deployment of physical assets is intended to improve flexibility and reduce aggregate facility requirements.

In support of its various functional responsibilities, the Coast Guard also has an extensive research, development, test, and evaluation program. The total outlay for these activities was $17.8 million in fiscal year 1976, and will total about $20 million in fiscal year 1977, and $20 million again in fiscal year 1978. Today a substantial share of the funding for Coast Guard R&D is devoted, directly or indirectly, to research-related activities in the area of pollution abatement and environmental protection.

In addition to the central role played by the Coast Guard in providing Federal assistance in support of marine navigation and safety, other Federal agencies also provide important support services in this area. Notable among these are the mapping, charting, and surveying services conducted by the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce and NOAA's weather forecasting and weather warning services. In 1976, more than $35 million was devoted by NOAA to mapping, charting ,and surveying activities and over $200 million was devoted to environmental monitoring, prediction, and warning activities. While these programs provide support for a wide variety of activities throughout the Nation, they are of particular importance to the safe and efficient operation of the U.S. marine transportation system.

In the next section brief consideration will be given to the water transportation infrastructure impact of various Federal initiatives relating to environmental protection and coastal zone management. These issues are treated in greater detail in the chapters devoted to Marine Environment and Ocean and Coastal Resource Management.

Integration of Nontransportation Objectives in the Development and Operation of the Marine Transportation System

In recent years growing public concern for environmental protection and better planning for competing uses of limited ocean and coastal resources has led to a broader Federal role in attempting to integrate these emerging social objectives equitably with traditional requirements for an efficient water transportation system. In the process new Federal organizations have been created which exert major influences on the U.S. marine transportation infrastructure. In addition, certain traditional agencies have been given extensive new responsibilities in these areas, and in all cases traditional Federal marine transportation activities have been at least partially influenced by the need for increased environmental protection and better water resource use planning.

The U.S. Coast Guard is, of course, the traditional organization that has assumed the bulk of the new responsibilities in the area of marine environmental protection. As the Nation's principal Federal marine law enforcement agency, many of these new responsibilities fit well with traditional law enforcement functions and many new programs designed to prevent pollution also contribute to traditional Coast Guard objectives in the areas of improved navigation and safety. As a consequence of these interrelationships, the Coast Guard has been the logical agency to assume the primary Federal burden of implementing and enforcing many of the new initiatives relating to the protection of the marine environment.

Although environmental protection is a relatively recent Coast Guard function, an important statutory authority for this function dates from as early as 1899. In that year the Congress passed the Rivers and Harbors Act, which prohibited the dumping of refuse into the navigable waters of the United States. This act, more commonly known as the Refuse Act, remained in place for many years, however, before becoming a major instrument in the fight against water pollution because of the narrow construction given to the term refuse. It was not until the mid-1960s that this was changed by a Supreme Court ruling.

In 1966, in the case of the United States vs. Standard Oil Company of Kentucky, the Supreme Court

held that the provisions of the Refuse Act were applicable to oil discharge despite the oil company's contention that a commercially valuable petroleum product should not be considered refuse.[20] In interpreting the term refuse as employed in Section 13 of the Rivers and Harbors Act, Justice Douglas, speaking for the Court, stated that:[21]

> "Oil is oil and whether useable or not by industrial standards it has the same deleterious effects on waterways. In either case, its presence in our rivers and harbors is both a menace to navigation and a pollutant. This seems to be the administrative construction of Section 13, . . ."

This judicial interpretation made the Refuse Act a major legal instrument in the battle against water pollution in the United States and a primary statutory authority for many Coast Guard environmental protection activities.

Before the 1966 ruling on the Refuse Act, the principal statutory foundation for Coast Guard pollution abatement activities was the Oil Pollution Act of 1961, which implemented the 1954 International Convention for the Prevention of Pollution of the Sea by Oil. Although this convention had come into force in 1958,[22] the United States did not become a party to the convention until the 1961 Oil Pollution Act was passed. Under the provisions of this act and the convention, limits were imposed on the quantity of oil and oily mixtures allowed to be discharged in zones extending 50 miles from land. Subsequent amendments to the 1961 Oil Pollution Act have tightened and extended these restrictions, and today U.S. requirements under this law are more stringent than requirements under the 1954 Convention. The current law is, however, consistent with various amendments to the convention which are now pending ratification by enough nations to bring them into force.[23]

In addition to the oil discharge standards contained in the law, this statute now also includes standards governing tank size and configuration for new U.S. tankers. These standards are intended to limit the quantity of oil outflow in the event of an accident and are consistent with international standards contained in a 1971 amendment to the 1954 Convention which is also now pending ratification. As the lead agency in implementing U.S. marine transportation laws passed pursuant to international safety and pollution abatement conventions, the Coast Guard plays a major technical role in all international negotiations relating to these agreements

Two other laws which provide extensive authority for current Coast Guard programs in the area of environmental protection were enacted in 1972. The Federal Water Pollution Control Act Amendments of 1972 represent perhaps the most far-reaching action yet taken by the Federal Government to confront the entire range of problems associated with water pollution. These amendments address not only the problem of pollution prevention but the problems of cleanup and liability as well.

Among its other provisions, the 1972 Water Pollution Control Act expressly prohibits the discharge ". . . of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines, or into or upon the waters of the contiguous zone . . ."[24] In addition, it authorizes the promulgation of regulations requiring the installation of certain pollution prevention equipment on merchant vessels; authorizes the Federal Government to undertake cleanup operations after a polluting spill; authorizes the establishment of a $35 million revolving fund to be used for cleanup; requires the promulgation of a national oil pollution contingency plan; establishes criminal penalties for those who have knowledge of and fail to report an unauthorized discharge; and places unlimited liability on those responsible for a spill where willful negligence or misconduct can be proved. In cases other than those involving willful negligence or misconduct and where the incident cannot be attributed to an act of God, war, or negligence on the part of the government or a third party, liability limits are specified. However, commercial interests using these waterways must maintain evidence of financial responsibility up to these liability limits with the Federal Government.[25]

In addition to the numerous provisions affecting the authority of the Coast Guard, the 1972 Water Pollution Control Act has also affected various other Federal agencies. For example, the Corps of Engineers Refuse Permitting program, carried out under the 1899 Refuse Act, was, for the most part, transferred to the Environmental Protection Agency by this legislation. The Corps, however, retained responsibility for issuing permits for the disposal of dredge and fill material and retained a residual re-

[20] U.S. vs. Standard Oil Company, 384 U.S. 225, 86 Sup. Ct. 1427, (1966).

[21] Ibid, p. 1428.

[22] Implementation of the original convention required agreement by a minimum of 10 governments, at least 5 of which were required to have not less than 500,000 gross tons of registered tanker tonnage. This requirement was met in 1958.

[23] Amendments to the 1961 Oil Pollution Act will not be activated until both the 1969 and 1971 Amendments to the 1954 Convention are ratified by the U.S. Senate. The 1969 Amendments to the 1954 Convention came into force, however, on January 20, 1978, and although not yet ratified by the United States, the Coast Guard has implemented the provisions of the 1969 Amendment through regulations issued under authority of the Ports and Waterways Safety Act.

[24] An Act to Amend the Federal Water Pollution Control Act, Public Law 92-500, October 18, 1972. 86 Stat. 48.

[25] It should be noted that certain provisions of the 1972 Water Pollution Control Act had actually previously been enacted in 1970 with passage of the Water Quality Improvement Act. The 1972 Act incorporated these earlier provisions and expanded and modified overall Federal water pollution authority.

sponsibility to assess the navigation impact of other permit requests filed with EPA.

Another affected agency was the Federal Maritime Commission, which was assigned responsibility for assessing the financial responsibility of tanker operators to meet the liability provisions of the Act. In addition, numerous other agencies and programs in the water resource area were affected significantly by provisions of this comprehensive legislation. A more extensive discussion of this legislation is included in the chapter on Marine Environment.

The second piece of legislation passed in 1972 which expanded the scope of Coast Guard environmental authority was the Ports and Waterways Safety Act. Before enactment of this legislation, Coast Guard port safety authority was based on various laws, including the Espionage Act of 1917, the Dangerous Cargo Act, the Tank Vessel Act, and the 1950 Magnuson Act. These legislative authorities generally limited Coast Guard port safety and security activities to periods during which a state of national emergency had been declared by the President. Under the terms of Executive Order 10173, President Truman provided the Coast Guard with the Presidential authority needed to pursue the port safety program. The regulations promulgated under the Magnuson Act and under Executive Order 10173 established Captains of the Port in 55 major port areas in the continental United States, Alaska, Hawaii, Puerto Rico, and Guam. These Coast Guard units were charged with enforcing regulations concerning vessel movements, anchorages, cargo transfer operations including both storage and stowage, and waterfront facility fire and safety regulations.

With enactment of the Ports and Waterways Safety Act in 1972, the Coast Guard was given responsibility for the establishment of minimum design, construction, alteration and repair standards for all oil carrying vessels using U.S. ports and navigable waters. Specifically, this act imposed a requirement for establishing standards pertaining to improved vessel maneuverability and improved stopping ability in an effort to reduce the likelihood of collision or grounding, and required the establishment of standards to reduce the quantity of cargo loss arising from an accident. In addition, standards for reducing environmental damage arising from normal vessel operations are required and a tankerman certification program is authorized. Furthermore, this legislation authorized the establishment of vessel traffic services and systems in congested traffic areas and the use of a variety of vessel traffic controls. Finally, this act authorized the establishment of safety zones, waterfront facility and environmental investigations, waterfront structure safety requirements, hazardous materials procedures, and pilotage requirements.[26]

[26] Port and Waterways Safety Act of 1972. Public Law 92-340, July 10, 1972. 86 Stat. 424.

Together with the environmental responsibilities undertaken in the 1960s, the Port and Waterway Safety Act and the 1972 Amendments to the Federal Water Pollution Control Act have greatly enlarged Coast Guard authority with respect to marine environmental protection. At the same time other new Federal environmental agencies and functions have emerged which also exert a significant influence on marine transportation.

Under the terms of Section 102 of the National Environmental Policy Act of 1969, for example, all proposed Federal actions significantly affecting the quality of the human environment must now be accompanied by a comprehensive environmental impact statement. In addition, the agency undertaking such action must obtain comments from all other interested Federal agencies having jurisdiction or special expertise with respect to the action in question. This process has significantly influenced Federal activities in support of the U.S. water transportation system by requiring explicit and detailed advance consideration of the likely environmental consequences of many Federally-supported water transportation-related activities. This process frequently extends the time required to achieve approval of a particular project or activity, increases the analytic effort required, and increases the visibility of negative environmental consequences which can further delay a project or result in its cancellation. This specific and detailed consideration of environmental consequences is, of course, the intended purpose of the new procedure and although the process itself no doubt imposes some additional costs, there seems to be a general consensus that the cost of failing to systematically include environmental considerations in the decision-making process would be far greater in the long term.

The 1969 National Environmental Policy Act also established the Council on Environmental Quality (CEQ), which is composed of three members and a staff in the Executive Office of the President. In carrying out its broad mandate to analyze the quality of the environment and make policy recommendations to improve that quality, CEQ has become an important strategic actor in shaping Federal marine transportation policies in light of environmental considerations. In 1970, for example, CEQ published the National Oil and Hazardous Materials Pollution Contingency Plan, which sets forth procedures to be followed in responding to a water pollution emergency. The objective of the plan is to assure a coordinated, efficient, and effective response to minimize the negative environmental consequences of such an incident. In 1973, CEQ played a major role in analyzing the environmental consequences of offshore deepwater port facilities including an assessment of the shoreside implications of such offshore facilities. From these examples it is clear that in dis-

charging its broad environmental responsibilities, the actions of CEQ will be increasingly important determinants of future Federal activities relating to both the operation and development of the U.S. water transportation system.

A second major new Federal environmental organization to emerge in recent years is the Environmental Protection Agency, and it, too, plays an important role in integrating environmental considerations into Federal marine transportation programs. Established as an independent agency by Reorganization Plan No. 3 of 1970, EPA administers a broad range of programs relating to environmental research, monitoring, standard setting, and enforcement. Under the Federal Water Pollution Control Act Amendments of 1972, EPA is charged with establishing and administering a joint Federal/State water permit program to govern the discharge of effluents into U.S. navigable waters, with the objective of eliminating the discharge of pollutants by 1985. This program imposes new water quality responsibilities and restrictions on many traditional U.S. port activities.

A related EPA activity which has affected water transportation pertains to the establishment of standards for pollutants in dredge spoil and standards for spoil disposal. Although permitting dredge material disposal is the responsibility of the Corps of Engineers, these activities and the Corps' own dredging must be carried out in compliance with overall water pollution standards set by EPA. Thus, the EPA standards can significantly affect the cost of port and waterway development by limiting the traditional practice of simply dumping spoil materials in open waters.

Finally, many EPA water-related programs and responsibilities are shared with the U.S. Coast Guard and conducted on a cooperative basis. Pollution abatement research and development and environmental law enforcement are two prominent areas in which these agencies work closely together in discharging their respective and, at times overlapping, environmental responsibilities. The close working-level relationships which have developed between the Coast Guard and EPA in these areas have proven effective in minimizing duplication of effort, while at the same time assuring that Federal responsibilities in these areas are efficiently discharged.

The growing demand for better planning and management of ocean and coastal resources has added yet another dimension to the analysis of U.S. marine transportation requirements. In response to this demand, the Federal Government has undertaken a leadership role in compelling more synoptic consideration of all of the competing demands (including transportation) on the scarce land and water resources of the coastal zone. The principal manifestation of this initiative is the 1972 Coastal Zone Management Act, which has greatly enlarged the responsibilities and authority of the National Oceanic and Atmospheric Administration with respect to overall coastal zone use planning.

Under the Coastal Zone Management Act, NOAA is charged with providing incentives to encourage States to develop and implement coastal zone management plans which are consistent with national objectives and that fully consider all of the various uses of coastal zone resources. NOAA activities in this area are carried out by the Office of Coastal Zone Management (OCZM), which provides States with technical information on coastal zone issues and helps them to evaluate their coastal resources and develop coastal zone management programs. In support of these efforts, OCZM is authorized to provide program development grants to States that are developing coastal zone management plans consistent with Federal guidelines. Once a plan is approved, annual administering grants are authorized to carry out the coastal zone management programs embodied in the plan. This grant program approach is designed to provide an incentive for State compliance with broad Federal guidelines, while at the same time retaining a local orientation within individual plans.

As a major competitor for the use of coastal zone resources, the marine transportation infrastructure will, of necessity, be a prominent element in the plans which will ultimately be adopted under this program. In turn this planning process, by giving full and detailed consideration to competing uses of the coastal zone, can be expected to affect the course of future U.S. development of the marine transportation infrastructure. A more thorough discussion of the entire Federal coastal zone management effort is included in the chapter on Ocean and Coastal Resource Management.

Major Current Issues

Several major issues are likely to dominate future Federal policy considerations relating to the development and operation of the U.S. marine transportation infrastructure. In turn, the resolution of these issues could significantly affect the fundamental nature of the U.S. marine transportation system and perhaps influence its ability to respond efficiently to the Nation's trade requirements. In the paragraphs below, these issues, most of which have already been discussed, will be briefly enumerated.

At the broadest level, the issue of appropriately integrating traditional marine transportation and

trade requirements with emerging social objectives such as environmental protection and marine resource use planning will continue to be a central national concern. While this process is likely to increase the controversy surrounding many marine transportation infrastructure initiatives, it will also assure that the anticipated social and economic costs and benefits of these programs receive full consideration before action is taken. Although there is no guarantee that all consequences can be accurately predicted, and while valuation of many of the anticipated consequences will remain elusive, the identification of as many of these consequences as possible will increase the likelihood of sound decisions.

A related although more specific issue will center on the continuing controversy surrounding the selection of an appropriate discount rate for evaluating the economic costs and benefits of future Federal water development projects. If proponents of a generally higher discount rate prevail, the economic justification of many federal water transportation projects, which characteristically yield benefits well in the future, will become more difficult. Unfortunately, the discount rate problem is not simply a technical issue and political considerations will continue to influence the positions taken on this issue.

Problems relating to infrastructure financing will continue to be issues of major concern at both the Federal and local levels. At the Federal level the user charge issue is likely to continue as a prominent point of controversy in this area. Basically, this issue will focus on arguments as to who the beneficiaries of Federal waterway activities are and who should pay for these programs. Opponents of user charges will continue to press the position that Federal waterway programs lead to general economic expansion, the benefits of which accrue to all citizens, and should therefore continue to be funded primarily from general revenues. Proponents of user charges, on the other hand, will argue that water carriers and users of water transportation services are the beneficiaries and should pay for these Federal services. In turn, opponents can be expected to cite the regressive effect of user taxes, which, at least in part, will be passed through to the ultimate consumers of goods transported by water. Proponents will point to an alleged misallocation of resources encouraged by providing one transport mode with government advantages unavailable to other modes. The recent Congressional compromise on this issue embodied in H.R. 8309 is probably just a lull in what promises to be a complex and protracted battle which will be waged at both theoretical and political levels. The resolution of this issue can be expected to affect not only the outlook for U.S. water transportation, but for the water-competitive portions of the rail and truck industries as well.

At the local level, the problem of port financing (particularly in the face of the increasing capital intensity of many port facilities) will continue to be a dominant issue. As a consequence, pressures will no doubt mount for additional Government financial assistance to help defray the cost of certain port development and operation activities. These efforts can be expected to focus, in the near term, on securing Federal funding to help pay for various mandated Federal requirements in the areas of port security, environmental protection, and safety. Essentially this issue, which has already been raised by port interests,[27] will elicit considerations similar to those associated with the user charge issue. The fundamental question raised by this issue is again who should pay for these programs—the general public who benefits from them or those who make them necessary.[28]

Finally, the controversy surrounding the appropriateness of aggregate U.S. port capacity in light of broad regional and national trade requirements is likely to become an increasingly important issue and will present a major challenge to the traditional Federal policy of nondiscrimination among ports. Rising port development costs will impose strong pressures to carefully husband limited resources, and the economies of scale inherent in bulk and general cargo handling procedures will tend to encourage a greater concentration of port capacity in fewer port areas. Specific issues to be confronted in this area will include the need to develop a limited number of deepwater ports to accommodate bulk commodities more efficiently and further consideration of the possible problem of aggregate inefficiency due to excess container handling capacity.

From the Federal perspective, the issue of container handling capacity is most likely to manifest itself in the area of economic regulation, as ports which lose traditional cargoes to new intermodal competitors (such as "landbridge" operations) seek Federal regulatory relief. In the next major section this issue will again be addressed as attention is directed to the overall Federal role in the economic regulation of the U.S. marine transportation system.

---

[27] U.S. Congress, House Merchant Marine Subcommittee of the Committee on Merchant Marine and Fisheries. Statement by Alfred M. Eschbach, President, American Association of Port Authorities, Inc., Washington, D.C., June 30, 1976, p. 8.

[28] The Maritime Administration will soon release the results of a survey that quantifies the costs imposed on public ports by various mandated Federal requirements in areas of environmental protection, employee health and safety, and cargo security.

Economic Regulation

The economic regulation of ocean shipping in U.S. foreign and domestic commerce is basically a 20th-century phenomenon. Before 1916, the only regulatory authority over such carriage was exercised by the Interstate Commerce Commission as an adjunct to its authority to regulate railroads. Under the terms of the Interstate Commerce Act of 1887, railroad regulation was defined to include the regulation of continuous intermodal cargo movements by a combination of rail and water carriers when carried out under common control or management. The clear objective of this provision was railroad regulation, however, and not water carrier regulation.

In general, during this early period water transportation was looked on with considerable favor as a means of at least partially curbing the extensive power of the railroads in areas where water carriage provided an alternative to rail transport.

With the opening of the Panama Canal, a new opportunity for rail/water competition emerged in the provision of important transportation services between the West Coast and the East and Gulf Coast areas of the United States. By this time, however, many water carriers had come under railroad control and, as a result, the socially desirable consequences of rail/water competition had begun to erode. To alleviate this condition, the Congress included in the 1912 Panama Canal Act an amendment to the Interstate Commerce Act which made it illegal for a railroad to have any interest in a water carrier with which it competed or might compete. Again, the purpose was to control the power of the railroads and assure the viability of the rail-competitive water transportation industry.

At about this same time, however, concern did begin to emerge regarding certain anti-competitive practices in shipping. Basically this concern focused on the liner segment of the industry, where it was felt that the nature of the service provided tended to encourage agreements designed to limit competition in order to prevent unlimited competition from becoming predatory. It is necessary to understand the distinction between the liner industry and other segments of the shipping industry in order to understand why Federal economic regulation of liner shipping services emerged. The general (although not total) confinement of Federal regulation to common carrier liner-type operations arises from a perspective which sees these services as economically distinct from services provided by other types of vessel operations.

Regulatory Imperatives

Basically there are three types of water transportation services, although at times some operations may exhibit characteristics of more than one type. First, there is the service provided by the private carrier which is owned by its primary user and devoted principally to the carriage of proprietary cargoes. These services are provided internally as an integral part of some larger business activity and because they are not offered to the public, they are generally outside the scope of Government economic regulation. Examples of this type of operation include tankers owned and operated by oil companies and ore carriers owned by steel and aluminum producers.

The second basic type of operation is the tramp service which is offered to shippers on a contract carriage basis. No fixed schedule or service is offered and vessels so employed move freely from trade to trade in pursuit of bookings. Cargo space may be secured for a single voyage or, in some cases, the entire vessel may be chartered for a period of years as is common in the oil industry where many long-term charters are used to provide services essentially indistinguishable from proprietary carriage. Characteristically, the tramp shipping industry is highly competitive, because of the ease with which shipping assets may be shifted from one trade to another in pursuit of new employment opportunities. This competitive characteristic provides a strong element of natural regulation which largely obviates the need for extensive Government involvement. In U.S. foreign trade such operations are totally outside the scope of Federal economic regulatory authority. In domestic commerce, the Interstate Commerce Commission exercises some authority over contract carriage, but only to the extent required to protect common carriers from unfair competition from contract carriers. Basically, contract carriers are forbidden from charging unreasonably low rates and must file a minimum rate schedule with the ICC. Any minimum rate determined by the ICC to be unreasonably low can be ordered raised, but the contract carrier owner remains free to charge any rate above the floor rate and there are no restrictions regarding rate discrimination among shippers.[29] Hence, while a limited Federal regulatory role does exist with respect to domestic contract carriage, this type of service in both foreign and domestic commerce remains primarily subject to the control of the market rather than the Government.

The third basic type of shipping operation is the liner service, which is characterized by the offering of water transportation services to the general public in accordance with a fixed, published schedule. Es-

[29] William L. Grossman, *Ocean Freight Rates*. Cambridge, Md., Cornell Maritime Press, 1956, p. 108.

sentially it is this fixed schedule which sets the liner service apart from other shipping services not only in terms of the type of service provided, but also, in the traditional view, in terms of the fundamental economic nature of this segment of the industry. It is suggested that it is this unique economic character of liner shipping which inevitably leads to the adoption of certain competitive practices that over time tend to destroy competition itself. In turn, it has been this view which has led to the regulation of this segment of the shipping industry in the United States while other segments have been left largely unregulated. The philosophical underpinnings of this regulatory involvement are briefly outlined in the following paragraphs.

Traditionally, the *nonliner* shipping industry has been characterized by relatively high variable costs compared to other capital-intensive transportation modes. That is to say, variable or operating costs have tended to be relatively more significant components of total cost than in other transport industries, whereas fixed or capital costs tend to be relatively less significant components of total cost. The importance of this characteristic is that it tends to ensure the maintenance of a substantial degree of competition in this industry. The ease with which shipping assets may be shifted in pursuit of new trade opportunities and the comparatively low capital cost of establishing a new competitive service yield a natural environment for relatively free and nondestructive competition.

In the provision of *liner* services, however, the fixed cost/variable cost relationship of the nonliner operator is fundamentally altered when vessels are committed to providing regular common carriage in compliance with a fixed schedule. Under these circumstances committed vessels are no longer free, at least in the short run, to simply respond to the imperatives of the marketplace. As a consequence, a far larger portion of total cost is effectively fixed for the period in which the regular liner service is offered.[30]

Relatively high fixed costs in the liner industry, in turn, present two major problems with respect to competition. First, it is suggested that entry into the industry or a particular trade is impeded by the large fixed cost commitment which must be made at the outset. Committing vessels for an extended period to a new service without assurance that the service will be remunerative is a major barrier to entry. Secondly, where competition in a particular trade exists, it is argued that it is likely to be extreme and ultimately destructive. Once large fixed-cost commitments have been made, competing carriers are encouraged to try to attract cargoes away from one another by cutting prices, often to the low level of variable costs. With the commitment to serve a particular trade already undertaken, it becomes naturally tempting to try to capture a little more cargo to fill any unused capacity by reducing rates below the total cost of providing the service, so long as the variable costs of handling the cargo can be covered. Inevitably, it is argued, competition of this sort will lead to serious rate wars and ultimately, if unrestrained, to the destruction of competition itself.

Next, it is suggested that because of the inherently destructive nature of competition in the liner trades, participants in the liner industry will privately seek ways to limit such competition. In response to this need, the liner conferences emerged as private means of controlling predatory competition in the liner industry. An association of all or some of the liner operators in a particular trade, the liner conference establishes a common rate structure which all members agree to follow in offering their services in the trade governed by the agreement. In this way a major dimension of competition is removed among parties to the agreement and each participant's chance of survival in the trade is improved. Frequently these agreements have emerged after major price wars and essentially constituted truce agreements among the survivors.

The inherent problem with the conference agreement is that while it provides participants in a particular trade with a useful means of protecting themselves from each other, the reduction in competition associated with the conference agreement itself may leave shippers and society no better off than if a single firm attained a monopoly position in the trade. Essentially this was the policy dilemma which began to emerge in the early 1900s in the United States. It was felt that to outlaw the conference system in the U.S. trades, while consistent with the prevailing U.S. antitrust philosophy, would ultimately lead to decreased competition in ocean shipping rather than its protection as unrestrained predatory competitive practices proceeded to their inevitable conclusion. On the other hand, the conference institution itself eliminated price competition altogether among its members and, uncontrolled, tended to adopt many of the socially objectionable practices of a monopoly. In the face of this growing dilemma, in 1912 the House Committee on Merchant Marine and Fisheries initiated a major investigation of the shipping conference system and its impact on U.S. trade and the shipping industry.

After 2 years of study, the House completed its assessment of the conference issue and in 1914 released its final report. In that study, known commonly as the Alexander Report, the Merchant Marine and Fisheries Committee basically concluded

[30] In recent years, this high fixed cost characteristic of liner shipping has become even more pronounced with the rapid introduction of containerization and other capital-intensive intermodal cargo handling procedures. These new cargo handling systems have required major capital commitments in both shoreside and seagoing equipment.

that the conference system was a necessary, though admittedly imperfect, institution that should be allowed to persist but which should be closely regulated and controlled by the Federal Government in order to protect shippers and society from its abuses. This report ultimately provided much of the basis for the regulatory provisions of the Shipping Act of 1916, which today remains a major statutory authority for the Federal economic regulation of shipping. The following two paragraphs from the Alexander Report [31] summarize its findings and the general philosophy upon which the Shipping Act of 1916 was predicated.

> "It is the view of the Committee that open competition cannot be assured for any length of time by ordering existing agreements terminated. The entire history of steamship agreements shows that in ocean commerce there is no happy medium between war and peace when several lines engage in the same trade. Most of the numerous agreements and conference arrangements discussed in the foregoing report were the outcome of rate wars and represent a truce between the contending lines. To terminate existing agreements would necessarily bring about one of two results: the lines would either engage in rate wars, which would mean the elimination of the weak and the survival of the strong, or to avoid a costly struggle, they would consolidate through common ownership. Neither result can be prevented by legislation, and either would mean a monopoly fully as effective, and it is believed more so, than can exist by virtue of an agreement. Moreover, steamship agreements and conferences are not confined to the lines engaging in the foreign trade of the United States. They are as universally used in the foreign trade of other countries as in their own. The merchants of these countries now enjoy the foregoing advantages of cooperative arrangements, and to restore open and cutthroat competition among the lines serving the United States would place American exporters at a disadvantage in many markets as compared with their foreign competitors.
>
> "While admitting their many advantages, the Committee is not disposed to recognize steamship agreements and conferences, unless the same are brought under some form of effective government supervision. To permit such agreements without government supervision would mean giving the parties thereto unrestricted right of action. Abuses exist, and the numerous complaints received by the Committee show that they must be recognized. In nearly all of the trade routes to and from the United States the conference lines have virtually a monopoly of the line service. The committee believes that the disadvantage and abuses connected with steamship agreements and conferences as now conducted are inherent, and can only be eliminated by effective government control; and it is such control that the committee recommends as the means of preserving to American exporters and importers the advantages enumerated, and of preventing the abuses complained of."

Regulation of Foreign Trade Shipping

With enactment of the Shipping Act of 1916, the United States became unique among major maritime nations in its assertion of the right to regulate the terms and conditions of competition in the carriage of its waterborne international commerce. While other major trading nations have, from time to time, investigated and expressed concern about the power of shipping conferences, only the United States has chosen the path of regulation to control this power.

For example, 5 years before the release of the Alexander Report, the Royal Commission on Shipping in Great Britain released a similar extensive report on shipping conference practices. While the Royal Commission also found serious abuses associated with the conference system, it recommended a private rather than public solution. Recognizing the value of conferences as stabilizing influences in ocean transportation, the Commission felt that the benefits of the conference system could be best maintained and the abuses best controlled through the encouragement of countervailing combinations of shippers and merchants who could bargain collectively from a position of power with the shipping conferences. Over the years this has been the general tactic adopted by most of the rest of the world and the United States has been frequently criticized

[31] U.S. Congress, House Committee on Merchant Marine and Fisheries. Steamship Agreements and Affiliations in the American Foreign and Domestic Trade. Washington, D.C., 1914. It should be noted that while the views expressed in the Alexander Report provide much of the foundation for contemporary U.S. regulatory policies, this philosophy has not gone unchallenged. Over the years there has been a substantial body of opinion which has held that the public would be better served by less government regulation and greater application of U.S. antitrust policies to the liner shipping industry. Proponents of this position argue that the presumption that unrestrained competition in liner shipping is inevitably destructive has been overdrawn.

for pursuing the alternative approach of Government regulation. Basically, foreign maritime nations have objected to the United States regulating the competitive practices of non-U.S. vessels. Despite these objections, however, this regulatory approach has been a consistent U.S. policy since 1916.

Essentially, the policy adopted by the United States with enactment of the Shipping Act of 1916 imposed strict new requirements on the competitive practices of all ocean common carriers in both foreign and domestic commerce while, in turn, granting antitrust immunity to approved conferences and certain other competition-limiting associations or agreements.[32] The competitive practices prohibited by the law extended to individual companies as well as to conferences, and all competition-limiting arrangements and associations were required to receive prior approval from the Government before activation. Furthermore, all such arrangements were required to provide for ". . . reasonable and equal terms and conditions for admission . . ." of non-affiliated shipping companies.[33] Hence, the 1916 Act, while allowing the conference system to exist in the U.S. trades, limited this authorization to so-called "open" conferences only. The "closed" conference, which limits membership and which is common elsewhere in the world was, and remains, prohibited in U.S. commerce.

Although the Alexander Report had recommended that the regulation of shipping be added to the responsibilities of the Interstate Commerce Commission, the Shipping Act instead established a new independent agency to discharge these regulatory responsibilities. The United States Shipping Board, which the 1916 Act established to carry out these duties, was, however, also given broad *promotional* responsibilities with respect to U.S. shipping and was authorized to build and operate ships for government account under the Emergency Fleet Corporation. At the time the Shipping Act was passed, the threat of war and the need to expand U.S. shipping capacity rapidly to meet wartime requirements focused most of the attention on the emergency provisions of this legislation rather than its regulatory provisions. In the aftermath of World War I, however, the emergency provisions of the Shipping Act passed into history, while the regulatory provisions have remained central to contemporary U.S. shipping regulation.

Over the period 1916–61 the regulatory activities of the Federal Government with respect to foreign trade ocean shipping were consistently vested in the same organization that carried out Federal promotional programs relating to the U.S. merchant marine. While this arrangement resulted in numerous problems over the years, it was a central feature of the United States Shipping Board (an independent agency from 1917 to 1933 and a component of the Department of Commerce from 1933 to 1936), the United States Maritime Commission (an independent agency from 1936 to 1950), and the Federal Maritime Board/Maritime Administration (both Department of Commerce units from 1950 to 1961). Not until 1961 were the Federal promotional and regulatory responsibilities in this area finally separated with the establishment of an independent five-man Federal Maritime Commission to carry out the regulatory duties and with the assignment of all promotional and subsidy functions to the Maritime Administration in the Department of Commerce. This is the present organizational arrangement of these functions, and today the foreign trade regulatory provisions of the Shipping Act of 1916 (together with other regulatory responsibilities) are carried out by the FMC.

In an effort to regulate the liner shipping industry effectively and yet allow a limited form of the conference system to persist, the Congress specified in Section 14 of the Shipping Act four types of competitive behavior which would be illegal for all common carriers (and/or conferences) engaged in U.S. commerce. These specific prohibitions, which are still in force, and which apply to both foreign and U.S.-flag carriers, will be briefly discussed in the following paragraphs.

The first practice to be specifically prohibited was the deferred rebate. Before 1916 such rebates were used to maintain shipper patronage and are still used for that purpose today in many non-U.S. trades. Essentially, ship operators offering such rebates agree to return a portion of the total freight paid for services in an earlier period to any shipper who agrees to ship all or some specified portion of his cargoes for some future period on vessels owned by the operator offering the rebate or, in the case of conferences, on vessels of conference members. This

[32] Among the major types of agreements regulated by FMC (and requiring specific FMC approval before implementation) are the following: 1) *Conferences and Rate Agreements* which contain provisions for fixing and requiring adherence to uniform rates, charges and practices relating to the receipt, carriage, and delivery of cargo for all members in a particular trade. Generally, rate agreements provide for the right of independent action by member lines. Conference agreements authorize rates for specialized commodities to be open. Conference and rate agreements with a membership of three or more must contain provisions describing the method or system used by the parties in policing the obligations thereunder. 2) *Pooling Agreements* which provide for the division of cargoes or revenues among participants according to a prearranged formula. 3) *Talking Agreements* which allow antitrust immunity to carriers in a particular trade who wish to discuss certain subjects related to the trade or who wish to hold talks preparatory to the establishment of some other type of agreement. 4) *Interconference Agreements* which are generally agreements between conferences serving naturally competing adjacent trades which are typically designed to achieve rate parity between conferences. Agreements of this last type are required to preserve the right of independent action for member conferences upon notification of other parties to the agreement.

[33] Shipping Act, 1916 (as amended), Section 15, 39 Stat. 728, Chapter 451, September 7, 1916.

device has been commonly used by conferences to keep existing customers from shifting to carriage by a nonconference line. Since the only way a shipper can collect his rebate is to agree to another period of exclusive patronage, the shipper faces a strong economic incentive to remain loyal to the conference and potential conference competitors face a major barrier in trying to attract customers away from the conference. As indicated, this practice was made illegal by the Shipping Act in all U.S. trades and this prohibition, like the other practices which are forbidden, extends to foreign-flag common carriers in U.S. foreign trade as well as to U.S. carriers.

The second practice forbidden by Section 14 was the use of so-called "fighting ships." Essentially, this device involves the selection of one or more vessels from among those owned by a particular company, or by members of a conference, to be operated at extremely low rates in head-to-head competition with a competitor on a particular route in order to drive the competitor from the trade. Losses on a conference-sponsored fighting ship operation are shared by all conference members, and, hence, the full economic resources of the conference can be brought to bear in the course of the competition. Since 1916, this practice, too, has been illegal in all U.S. trades.

The third practice outlawed by the Shipping Act was the practice of discriminating against shippers as punishment for nonpatronage. Essentially, Section 14 made it illegal for any common carrier in U.S. ocean commerce to retaliate against a shipper by refusing to carry his cargo when space is available or to otherwise discriminate against a shipper as a consequence of the shipper's patronage of another carrier.

Finally, Section 14 included a more general prohibition against any unjust or unfair discrimination among shippers. This provision, and others similar to it elsewhere in the Act, basically requires that all common carriers by water in U.S. commerce offer their services on equal commercial terms to all equally situated shippers.

In 1958, a judicial interpretation of this last provision held that the language contained in Section 14 with respect to discrimination also prohibited the common practice of offering dual rates.[34] Under this arrangement, a lower rate schedule is offered to shippers who sign contracts agreeing to exclusively patronize conference carriers while a higher schedule is offered to shippers who do not agree to exclusive patronage.

Although the 1958 judicial interpretation outlawed the dual rate practice, this policy was quickly reversed when in August 1958 the Congress amended the Shipping Act to specifically authorize dual rate systems if approved in advance by the Federal Government. In 1961, specific terms and conditions required for dual rate contract approval were added to the Shipping Act. Basically, the 1961 amendment authorizes approval of dual rates so long as they are not detrimental to U.S. commerce, contrary to the public interest, or ". . . unjustly discriminatory or unfair as between shippers, exporters, importers, or ports, or between exporters from the United States and their foreign competitors . . ." [35]

The 1961 dual rate provision also set the maximum rate discount for exclusive patronage at 15 percent. Although a statutory maximum, this 15 percent differential in dual rate contracts has become the norm. In processing dual rate contract applications since 1961, FMC has denied approval to dual rate systems which extend shipper patronage requirements beyond a single trade and to systems providing for more than two rate levels.[36]

While the Shipping Act required prior Federal approval of all conference agreements and related competition-limiting arrangements and while it did require conferences to file rate schedules and expressly prohibited certain competitive practices, as originally drawn the 1916 Act did not require independent common carriers to file rate schedules with the Federal Government. It was not until 1961, when Section 18b was added to the Act, that such filings were made mandatory for independent carriers as well as conferences.

While the addition of Section 18b (and at the same time, the addition of Section 14b, which required dual rate contract filings), substantially expanded Federal regulatory authority with respect to foreign trade ocean carriers, this authority remains limited compared to the Federal ratemaking authority exercised over domestic carriers. The Federal Maritime Commission today may disapprove a foreign trade rate ". . . which, after hearing, it finds to be so unreasonably high or low as to be detrimental to the commerce of the United States." [37] However, under such circumstances, the FMC may not suspend the rate pending a determination of its reasonableness. Under this section, FMC may disapprove a challenged rate only *after* the required hearing has been held. In cases where a rate is challenged on the basis of discrimination under Section 17, the Commission authority is broader and a new rate may be prescribed (after hearing) to correct such an inequity.

[34] Federal Maritime Board vs. Isbrandtsen Company, 356 U.S.C. 481 (1958).

[35] Shipping Act, 1916 (as amended), Section 14b, 39 Stat. 728, Chapter 451, September 7, 1916. Another result of the 1961 amendments was to mandate that conference tariffs be made available to shippers at a subscription fee. Previously the nonavailability of some conference tariffs was hindering the shipping public.

[36] U.S. Department of Justice, Antitrust Division. *The Regulated Ocean Shipping Industry*. Washington, D.C., Government Printing Office, January 1977, p. 148.

[37] Shipping Act of 1916, Section 18b(5).

This rate regulation authority is substantially less extensive than that exercised by the Federal Government with respect to domestic water carriage. As noted in a recently published Justice Department study, the Shipping Act of 1916 and the Intercoastal Shipping Act of 1933 provide the Federal Government with extensive ratemaking authority with respect to domestic waterborne common carriage.[38] It is to this domestic waterborne transportation regulation that attention will now be directed.

Regulation of Domestic Trade Shipping

Under the terms of the Shipping Act of 1916, the regulatory authority granted to the United States Shipping Board extended to ocean and Great Lakes common carriers in interstate domestic commerce as well as to common carriers in the U.S. foreign trades. But while the major trade practice prohibitions and requirements imposed on foreign trade common carriers applied equally to domestic common carriers, the domestic carriage rate regulation authority of the Board was, from the beginning, far greater than its foreign trade rate regulation authority. For example, while it was not until 1961 that foreign trade tariffs of independent carriers were required to be filed with the Federal Government, tariffs for domestic ocean and Great Lakes common carriage were required under Section 18 of the Shipping Act as originally enacted.

It is important to note, however, that this early authority to regulate domestic rates, while clearly greater than the authority to regulate foreign trade rates, was limited in two important respects. First, the 1916 Act required only that maximum rates be filed with the Shipping Board and left carriers free to charge rates below the maximum so long as some other provision of the Act was not violated in the process. The Board was, however, granted authority to prescribe a new maximum rate upon finding a particular rate unjust or unreasonable, and unjust or unreasonable trade practices could also be set aside. Nonetheless, the original domestic trade ratemaking authority available under this rate ceiling approach was significantly more constrained than the authority exercised today by the Federal Government in this area.

The other major limitation on the original authority of the Shipping Board with respect to domestic water carriage regulation derives from the definition contained in the Act of domestic carriers subject to its provisions. Because only ocean and Great Lakes interstate common carriers were included in the domestic water carrier definition, the entire inland waterway system was excluded from the regulatory authority of the Government (except, of course, for the rail-related regulatory authority exercised by ICC). Furthermore, all contract and private carriers in the domestic ocean trades were beyond Federal jurisdiction under this definition.

The first important expansion of Federal domestic trade regulatory authority came in 1933. Following World War I, intense competition developed in the carriage of intercoastal domestic commerce via the Panama Canal and demands for expanded Federal regulation to control this situation began to emerge. In 1933, the Congress responded with enactment of the Intercoastal Shipping Act, which required both common and contract carriers to file tariffs with the Shipping Board for all domestic intercoastal carriage provided via Panama. Such tariffs were required to specify the exact rate to be charged rather than a minimum, maximum, or range of rates, and the Shipping Board was given broad authority to suspend unjust or unreasonable rates and practices. Hence, in this one trade area, Federal regulatory authority was simultaneously extended to include contract carriers and substantially expanded with respect to ratemaking and rate regulation.

In 1938 the relevance of the Intercoastal Shipping Act, with respect to the regulation of domestic shipping, was greatly enlarged by an amendment which extended the provisions of the 1933 law to all domestic trade common carriers as defined in the Shipping Act of 1916.[39] With this amendment, the Intercoastal Shipping Act of 1933 became the primary statutory authority for Federal regulation of domestic water transportation rates. In compliance with this legislation, domestic ocean and Great Lakes common carriers were required to file new tariffs with the U.S. Maritime Commission (which by this time had assumed the responsibilities of the Shipping Board) reflecting actual, rather than maximum, rates for domestic service. In addition, all such carriers became subject to expanded Federal ratemaking authority because it was no longer a rate ceiling which had to be fair and just, but a specific rate. Under this expanded authority, rates could be suspended by the Maritime Commission if found to be either too high or too low, and the Commission was authorized under such circumstances to prescribe appropriate rates for the services in question. Thus, together, the Shipping Act of 1916 and the Intercoastal Shipping Act of 1933 became the two prin-

[38] U.S. Department of Justice, op. cit. note 36, p. 36.

[39] Interestingly, the 1938 amendment did not include extension of the rate provisions of the Intercoastal Shipping Act to other domestic contract carriers. Thus, while common carriers in all domestic interstate ocean and Great Lakes trades became subject to the Intercoastal Shipping Act, the only domestic contract carriers subject to this legislation were those operated in intercoastal services via the Panama Canal as originally specified when the Act was first passed.

cipal statutes upon which Federal domestic water carrier regulatory authority rested at the end of the 1930s.

Although Federal authority over domestic water carriage had been expanded substantially with enactment of the 1938 amendment to the Intercoastal Shipping Act, inland water carriers remained largely beyond Federal regulation. The ICC, of course, did exercise some limited jurisdiction over those transportation services offered jointly by rail and water carriers and water carriage provided by railroad subsidiaries, but this authority was directed primarily at controlling the competitive practices of the railroads and excluded water transportation unaffiliated with rail carriage. The ICC role in regulating rail-related water carriage also meant that Federal authority in this area was divided between two agencies. By 1940, pressures emerged for the consolidation of this domestic regulatory authority and for the extension of general Federal regulation to the inland waterway system.

In 1940, legislation was passed which accomplished the desired consolidation of regulatory authority and extended Federal regulation to the inland system. With enactment of the Transportation Act of 1940, which added a new Part III to the Interstate Commerce Act, the bulk of Federal regulatory authority over domestic water transportation (including the inland system) was vested in the Interstate Commerce Commission, leaving to the U.S. Maritime Commission (and its successors) primary responsibility for the regulation of foreign trade carriage. The single exception to this foreign/domestic division of responsibility was in the offshore domestic trades between the continental United States and Hawaii, Alaska, and U.S. territories. In these noncontiguous domestic trades, the Maritime Commission retained primary responsibility for water carrier regulation. All territorial trades were exempted from inclusion under ICC authority by the 1940 Act itself, and, when Hawaii and Alaska became States, the authority of the Maritime Commission over these trades was preserved by the statehood legislation. Regulation of these noncontiguous domestic trades continues to be governed primarily by the terms of the Intercoastal Shipping Act of 1933, as amended, subject to the trade practice prohibitions of the Shipping Act of 1916.

In addition to bringing the inland waterway system under Federal regulatory authority, the Transportation Act of 1940 also extended domestic water regulation to certain contract carriers, although regulatory authority in this area has remained limited and is primarily designed to protect common carriers (of all modes) from unfair competition. Basically, regulated contract carriers are required to file with the ICC only the lowest rates actually charged for their services and are free to charge higher rates as they wish. The ICC may raise floor rates found to be so unreasonably low as to result in unfair competition, but has no power to lower rates.

Although many of the provisions of the Shipping Act and the Intercoastal Shipping Act were repealed by the Transportation Act of 1940 with respect to the water carriage made subject to ICC jurisdiction, similar trade practice prohibitions and standards were incorporated in the new legislative authority. Tariff filings were required, and rates could be overturned by ICC if found to be unreasonably high or unreasonably low. Unjustly discriminatory rates and practices were outlawed, and agreements among common carriers relating to rates were allowed and given antitrust immunity if approved in advance and if individual participants retained the right of individual action. Thus, in general, the basic regulatory authority previously exercised by the U.S. Maritime Commission over part of the domestic water transportation system was simply transferred to ICC and expanded to include the inland waterway system and contract carriers. The specific ICC authority over domestic water transportation is, however, replete with exceptions and exemptions and, as a consequence, is highly complex. After delineating most of the major exceptions and exemptions, one author has identified three major elements of the domestic water transportation system which remain generally within the jurisdiction of ICC: ". . . common carriage of nonbulk freight; common carriage of dry bulk cargo on the high seas and Great Lakes; and intercoastal contract carriage of dry bulk cargo, when substantially competitive with common carriage (by water, rail, or highway)." [40]

In addition to the domestic carriage line haul operations subject to ICC authority, numerous other water transportation-related services also fall within ICC jurisdiction under various provisions of Part III of the Interstate Commerce Act. Authority in this area extends to such services as delivery, elevation, transfer in transit, refrigeration, storage, and similar transportation-related services offered to the public.

It is also important to note that ICC authority under the 1940 Act includes the regulation of the domestic portion of foreign trade water transportation services before or after trans-shipment in the carriage to or from a foreign location. With the growth of intermodalism in recent years, and the increasing use of through transportation rates, jurisdictional problems between ICC and FMC have become more and more common in this area. Since foreign trade-through rates may include in a single rate charges for both foreign trade and domestic trade services, it is often not clear which authority should govern such rates. Hence, while a major motivation for enacting the Transportation Act of

[40] William L. Grossman, op. cit. note 29, p. 106.

1940 was to eliminate jurisdictional overlaps in Federal regulatory authority, the growing use of through rates to cover a combination of foreign and domestic transport services is blurring the regulatory boundary established by the 1940 Act between foreign and domestic commerce. Jurisdictional disputes in this area are likely to continue until authority in this area is more precisely allocated either through judicial interpretation of existing law or enactment of new legislation.

Other Regulatory Responsibilities of ICC and FMC

Beyond the activities carried out by the Interstate Commerce Commission and the Federal Maritime Commission relating to the economic regulation of water carriers, various additional regulatory duties are discharged with respect to other aspects and components of the water transportation system. As indicated in the previous section, Part III of the Interstate Commerce Act grants authority to ICC to regulate many services provided in conjunction with water transportation in addition to the line haul itself. In this same area, under the terms of the Shipping Act of 1916, the FMC exercises extensive authority in the regulation of marine terminal operations carried out in conjunction with waterborne common carriage in foreign commerce and in conjunction with domestic interstate ocean and Great Lakes commerce. In this capacity FMC promulgates rules and regulations governing the activities of terminal operators and conducts surveillance, investigates charges, and renders decisions relating to discriminatory rates, practices, and other illegal activities. All U.S. terminal operators serving common carriers by water must publish and file tariffs with FMC specifying rates, charges, rules, and regulations governing their services. Furthermore, agreements between and among terminal operators and common carriers which affect or limit competition must be filed with and approved by FMC before receiving antitrust immunity under Section 15 of the Shipping Act.

Interestingly, it is ICC rather than FMC which has responsibility to help assure that offshore oil ports and related storage facilities are operated as common carriers. Under Section 8 of the Deepwater Port Act of 1974, authorized offshore oil facilities must be operated on a common carrier basis subject to ICC regulation in order to be eligible for a Department of Transportation license. If there is reason to believe that a licensed facility is not being operated in compliance with this requirement, an appropriate investigation and proceeding before ICC may be initiated.

Freight forwarders in domestic commerce (except in the noncontiguous domestic trades) are also regulated by ICC under the terms of Part IV of the Interstate Commerce Act, which was added to the basic legislation in 1942. Under the provisions of Part IV such forwarders are generally required to ". . . charge reasonable rates, refrain from unjust discrimination, file their rates in tariffs, etc."[41] Although regulated domestic forwarders may employ water carriers in the provision of line haul transportation services, it is much more common for domestic forwarders to use rail or truck services. In the domestic trades, freight forwarders assume the responsibilities of a common carrier and are regulated as common carriers.

In foreign commerce and in the noncontiguous domestic trades, FMC exercises Federal regulatory authority over so-called Non-Vessel Operating Common Carriers (NVOCC), which are business entities analogous to the domestic freight forwarders regulated by ICC. Basically, an NVOCC can be described as a person or firm which holds itself out (by the establishment and maintenance of tariffs, by advertisement solicitation, or otherwise) to provide transportation for hire by water in commerce subject to the jurisdiction of FMC; which assumes responsibility or has liability imposed by law for the safe transportation of shipments; and which arranges in its own name with underlying water carriers for the performance of such transportation whether or not owning or controlling the means by which such transportation is effected. Although an NVOCC is essentially the same kind of entity as the domestic freight forwarder regulated under Part IV of the Interstate Commerce Act, FMC does not place special restrictions on NVOCC operations, as is the case with ICC regulation of domestic freight forwarders. A non-vessel operating common carrier is afforded the same status as a vessel operating common carrier in terms of FMC regulation.

In addition to its regulatory authority over NVOCCs, FMC also licenses and regulates independent ocean freight forwarders, which, unlike the domestic forwarders regulated by ICC, assume no common carrier responsibilities and therefore file no tariffs or transportation rates. Independent ocean freight forwarders serve merely as export agents for other persons. FMC authority in this area was provided under the terms of a 1961 amendment to the Shipping Act, which authorizes the Commission to license forwarders subject to its jurisdiction and to regulate their activities to assure compliance with Federal shipping statutes. Ocean freight forwarders are required to be licensed by FMC after a finding

[41] William L. Grossman, op. cit. note 29, p. 114.

that they are "fit, willing, and able" to carry on the business of forwarding. The statute further provides that no person may be licensed who is controlled directly or indirectly by an exporter from the United States, or who has a beneficial interest in export cargoes. Freight forwarders are also subject to the general regulatory provisions of the Shipping Act of 1916, as "other persons" subject to the Act.

In addition to responsibilities relating to the regulation of competition and trade practices, FMC is also responsible for assuring the financial capability of certain carriers to meet various legally-specified liability requirements. Basically these responsibilities relate to passenger vessels serving U.S. ports and, with respect to pollution liability, to almost all vessels over 300 gross tons using U.S. waters. Under the terms of Public Law 89-777, owners, operators and charterers of passenger vessels with accommodations for 50 or more persons must establish and maintain with FMC evidence of their financial responsibility to meet liability obligations to passengers or others for death, injury, or nonperformance on voyages to or from the United States. Certificates (required for operation in the U.S. commerce) are issued to carriers that apply to the Commission and are found financially responsible to meet these liability obligations.

Financial responsibility obligations are also imposed on the owners and operators of all U.S. and foreign vessels of over 300 gross tons (except public vessels and certain non-self-propelled barges) under the provisions of Section 311(p)(1) of the Federal Water Pollution Control Act. Financial responsibility in this area is designed to assure adequate resources to meet liability obligations associated with a spill or other illegal polluting discharge. Carrier obligations under this law are also assured by an FMC certification program. Although this program has been in effect since April 3, 1971, with respect to oil spills, it has not yet been expanded to cover spills of other hazardous substances. Before implementation of the expanded program, the Environmental Protection Agency must specifically identify the substances to be included and establish various pollution standards for these materials. The development of EPA standards in this area is reportedly now nearing completion.

Special liability requirements are imposed on vessels carrying Alaska North Slope oil under the terms of the Trans-Alaska Pipeline Authorization Act of 1973 and assuring financial responsibility up to these limits is also within FMC authority. In implementing this program, FMC has required carriers engaged in the Alaska trade to maintain evidence of financial responsibility to meet the liability requirements of both the Federal Water Pollution Control Act and the Trans-Alaska Pipeline Authorization Act.

It is interesting to note that a similar requirement relating to vessel financial responsibility for oil pollution liability in conjunction with deepwater offshore ports was vested with the Department of Transportation under the terms of the Deepwater Port Act of 1974. Once one or more deepwater ports become operational, this provision will fragment Federal responsibility in this area unless new overriding legislation is enacted to deal comprehensively with the oil spill liability issue. Comprehensive legislation on oil spill liability is now being considered by the Congress, but it is not yet clear where overall responsibility for assuring financial responsibility will be vested.

Major Current Issues

Jurisdictional problems relating to the authority of ICC and FMC are likely to continue as prominent regulatory issues as containerization and other unitized cargo handling operations continue to expand. The increasing use of through bills of lading and single rates for movements having both international and domestic components will continue to tax the traditional domestic trade/foreign trade division of responsibility between these agencies. Both agencies generally support the concept of intermodal development, and both are represented, along with the Civil Aeronautics Board, on the nonstatutory Interagency Committee on Intermodal Cargo (ICIC). But despite this support for the concept of intermodalism, fragmented regulatory authority remains an impediment. Although the ICIC has succeeded in improving some of the commercial aspects of intermodal carriage, progress in resolving jurisdictional disputes among the three parent agencies has been limited.

In the past the FMC and various marine conference carriers have supported legislation which would allow FMC to grant antitrust immunity under the Shipping Act to certain intermodal arrangements in order to facilitate intermodal development. Under such legislation, arrangements receiving immunity would be subject to FMC approval and regulatory authority. Both the Justice Department and ICC have opposed such legislation. Justice, which has been a frequent critic of the U.S. policy of granting antitrust immunity to shipping conferences, does not want to see this policy extended, and ICC feels that intermodal development has not been unduly retarded under existing law and, therefore, sees no need for new legislative authority.

Another regulatory issue of growing importance is

also closely tied to intermodal development. As indicated in the previous section, containerization and other unitized cargo handling techniques have placed strong pressures on the traditional Federal port policy of non-discrimination. These pressures have found clearest expression in the regulatory process where Federal decisions with respect to intermodal operations can significantly affect port prospects. A number of intermodal operations are now being challenged before both FMC and ICC by ports that are losing traditional cargoes to these new services.

Rate absorption is a fundamental issue in many of these port-related cases. In the past FMC has generally allowed ocean carriers to offer a through-single-rate service and absorb the cost of overland transportation from the port of call to another port region *only* in cases where adequate service was not available at the second port or in certain other very limited situations, such as emergencies. However, FMC policy in this area is still evolving as the Commission attempts to balance the advantages of expanded intermodalism against the potential damage to specific ports and to the traditional concept of non-discrimination. Ports damaged by new intermodal services can be expected to continue to argue to the FMC that they are being discriminated against unfairly by the diversion of naturally tributary cargoes to other ports.

The port position is also being pursued before ICC, which has authority to disallow domestic rates that are noncompensatory. Because a through rate has a domestic portion that is subject to ICC jurisdiction, damaged ports have sought ICC disallowance of through rates on the grounds that the domestic portion is illegally low. It seems likely that balancing port considerations against the benefits of expanded intermodal carriage will be complicated by the involvement of two Federal regulatory authorities. This is another manifestation of the growing jurisdictional problem which has accompanied the growth of intermodal transportation.

In addition to the issues associated with regulatory jurisdiction and intermodalism, even more fundamental concerns are likely to emerge in the next few years regarding the overall appropriateness and adequacy of the present U.S. ocean shipping regulatory system. As indicated, the Justice Department has frequently criticized the granting of antitrust immunity to regulated shipping conferences and has recently released a major study that is highly critical of the present system. Basically the study concludes that conference abuses have not been effectively controlled by either market forces or Government regulation and that major changes should be made to current shipping legislation with the aim of increasing competition in the shipping industry.[42]

The Justice Department allegation that the U.S. regulatory system has not been effective in controlling illegal practices gained considerable credibility with the recent agreement by Sea-Land Services, Inc., to pay a $4 million fine to FMC for extensive rebating activities between 1971 and 1975. Although investigations are still continuing, there are indications that such rebating has been widespread in the U.S. trades in recent years despite its prohibition.

Supporters of the existing U.S. regulatory system, seeing major problems in any attempt to extend U.S. antitrust laws to foreign-flag carriers, have urged a basic strengthening of the present regulatory system to provide FMC with expanded authority to deal more effectively with illegal rebating practices—particularly with respect to foreign-flag vessels. While FMC authority over U.S. carriers is clear, its powers to investigate foreign-flag operations have proven more difficult to exercise. By simply refusing to supply subpoenaed records and information (frequently in compliance with laws at home) foreign-flag carriers have often been able to thwart FMC rebating investigations without fear of U.S. Government reprisal. This situation has prompted the Congress to consider amendments to U.S. shipping laws which would impose new penalties on foreign carriers who refuse to comply with FMC investigations. One suggested approach would prohibit such uncooperative foreign lines from entering U.S. ports. Further consideration of how best to deal with the rebating problem in the months ahead is likely to raise a variety of issues relating to the fundamental nature of the present U.S. shipping regulatory system.

Interest in reassessing Federal liner regulation has also been expressed by the Maritime Administration, which recently signed a major contract with the consulting firm Harbridge House for a 1-year study of the outlook for the U.S. liner fleet, assuming three alternative future regulatory environments. This study will first assess the economic outlook for the U.S. fleet if the current regulated "open" conference system is retained. Second, the impact of a more competitive environment, such as the one urged by the Justice Department, will be analyzed. And finally, an assessment of the U.S. liner outlook will be made assuming a less competitive environment in which "closed" conferences are authorized in U.S. commerce. The Chairman of the House Merchant Marine and Fisheries Committee has recently indicated that his committee will soon consider legislation to authorize some form of "closed" conference system. Hearings on such a measure are also likely to spawn a fundamental and thorough-going Congressional reassessment of U.S. shipping regulation. As has been the case in the past, U.S. fleet promotional considerations are likely to figure prominently in these deliberations and the findings of the Harbridge House study will, no doubt, be carefully considered during such Congressional hearings.

[42] U.S. Department of Justice, op. cit. note 36, p. 237.

One final major regulatory issue which will continue to receive close consideration relates to the problem of controlling the competitive practices of state-owned shipping companies which, in recent years, have been aggressively seeking a larger role in the carriage of U.S. foreign commerce. Such carriers, primarily of Soviet registry, have been charged by their competitors with cutting rates to levels which are not fully compensatory in order to achieve rapid trade penetration gains which, it is suggested, are motivated more by political objectives than by commercial considerations. The Soviets have, in turn, countered that their rates are not lower if the extensive illegal rebating activities of their competitors are taken into account. As a result of these charges and countercharges, the rebating and rate-cutting issues have recently become increasingly intertwined.

In attempting to resolve the rate-cutting issue, former FMC Chairman Karl Bakke met with Soviet maritime officials in July 1976 and successfully negotiated an agreement concerning the terms of Soviet liner participation in the carriage of U.S. waterborne foreign commerce. Under the provisions of the so-called Leningrad Agreement, Soviet officials basically agreed to adjust rates as quickly as possible in all U.S. liner trades to at least the level of the lowest rate offered by other competing independent carriers and to begin negotiations for entry into the Atlantic and Pacific conference systems.

In the wake of the Leningrad Agreement, various legislative initiatives, which had been undertaken to provide FMC with new authority to deal with Soviet rate-cutting practices, were suspended to see how well the new agreement would work. The suspension of these efforts, however, was temporary as Congressional impatience grew over the slow pace of progress under the Leningrad Agreement. In May 1977, Chairman Bakke himself suggested that progress had been inadequate and urged the Congress to pursue a legislative solution to the rate-cutting problem.[43]

Legislative proposals which have thus far been advanced to address the rate-cutting issue would amend the Shipping Act of 1916 to require nonnational, third-flag carriers (vessels not registered under either U.S. flag or the flag of the U.S. trading partner in a particular trade) to maintain rates with the FMC which are no lower than the lowest rates filed by any national flag carrier for the same services. FMC would be allowed to authorize lower rates only upon finding such rates to be commercially compensatory. Under the terms of one legislative proposal in this area, only State-owned nonnational carriers would be subjected to these new requirements, while an alternative proposal would extend this authority to all third-flag vessels engaged in the carriage of U.S. liner commerce.

In the face of continued Soviet expansion in the carriage of U.S. commerce and with the continued offering of liner services at what appear to be noncompensatory rates, pressure for Congressional action in this area is likely to grow. As a consequence, the third-flag rate-cutting issue promises to continue as a major regulatory concern.

Promotion of U.S. Shipping and Shipbuilding

Federal promotion and protection of the U.S. merchant marine date from the beginning of our history as a Nation. And while the scope and nature of this support have varied from period to period, the provision of Federal maritime assistance, in one form or another, has been a consistent U.S. policy.

Over the years a number of justifications have been advanced in support of Federal programs designed to foster U.S. shipping and shipbuilding. These justifications, which have assumed varying positions of relative importance during different periods of our history, may be classified under three general headings —national security, international political considerations, and economic benefits.

National security considerations have consistently played a predominant role in shaping and justifying Federal involvement in the promotion and protection of the U.S. merchant marine. The importance of maintaining a domestic shipping and shipbuilding capacity has been repeatedly demonstrated during periods of war and other national emergencies, and the security requirement for a U.S. maritime capacity is today probably the most widely recognized and supported justification for Federal involvement in this area.

The security requirement for a national merchant marine is generally defined to include two components. The defense component consists of the shipping and shipbuilding capacity needed to assure rapid deployment and resupply of U.S. armed forces in time of war, while the economic security component represents a broader requirement to assure the continued viability of the economy under wartime or other national emergency conditions. The growing dependence of the United States on foreign raw materials has greatly increased the importance of this second component of national security in recent years.

Closely related to national security are certain international political considerations which have also frequently been cited as motivations for Federal support for the U.S. merchant marine. Merchant ships, like

[43] U.S. Department of Commerce, Maritime Administration, Office of Policy and Plans, Division of Special Studies. *Expansion of the Soviet Merchant Marine into the U.S. Maritime Trades.* Washington, D.C., Government Printing Office, August 1977, p. 43.

naval vessels, may serve as visible expressions of national power and prestige abroad and such vessels and citizen crews play a representational role that can help implement U.S. foreign policy. At an even more general level, it has been suggested that national prestige, national pride, and our commitment to economic competition demand participation by the United States in these internationally competitive industries. In his message proposing legislation which was to become the Merchant Marine Act of 1936, President Roosevelt included the following statement of this political imperative:[44]

> "In such free competition, the American people want us to be properly represented . . . Their Government owes it to them to make certain that [American] ships are in keeping with our national pride and our national needs."

Over the years, a variety of economic benefits have also been cited in support of Federal assistance for the U.S. merchant marine. First, U.S. shipping and shipbuilding offer human and material resource employment opportunities which, in some circumstances, might otherwise be unavailable. Such justifications have been particularly important during periods of high national unemployment and in regions of the Nation which face chronic employment problems and in which the maritime industries provide many of the available job opportunities.

The regional employment argument has been particularly persuasive in recent years with respect to Federal support for shipbuilding. As of December 1977, for example, nine U.S. shipyards were engaged in the construction of merchant vessels with construction-differential subsidy assistance. All nine of these shipyards are in areas classified by the Department of Labor as having substantial unemployment. The shipbuilding employment opportunity argument is further advanced by the relatively high proportion of minority workers in this industry. Such workers consistently face greater employment difficulties than their non-minority counterparts in the labor force and, in many areas, shipbuilding has become a major source of jobs and training for minority employees.

The other economic justifications most frequently advanced in support of Government aid to the maritime industries stem primarily from international trade considerations. It has been argued, for example, that a U.S. presence in the carriage of our foreign commerce helps assure the maintenance of a competitive environment which, in turn, assures the continuation of fair and reasonable ocean freight rates and reliable ocean transportation services. In this way, it is suggested, U.S. shipping makes a direct contribution to the maintenance and expansion of U.S. foreign commerce. National flag ocean transportation has also been encouraged as a means of opening new markets for our export products. This justification was of particular importance in the early period of our history when merchant ships carrying goods around the world provided the principal means of exposing potential customers to new products and to new sources of supply. Finally, balance of payment savings have been cited as an important benefit of maintaining strong U.S. shipping and shipbuilding industries, especially during periods of high or chronic deficits in the balance of payments. To the extent that U.S.-built vessels and U.S.-owned and operated shipping services obviate part of the requirement for foreign vessels and services, balance of payments savings accrue to the Nation.

It is important to note that today, like many of the other benefits associated with Federal support for the merchant marine, the balance of payments benefit is not generally cited as a major justification for Federal support, but rather as one of the many ancillary benefits which derive from this policy. As suggested previously, it is probably national security that today provides the primary justification for Federal support for the U.S. maritime industries. Nonetheless, while the international political and economic benefits associated with U.S. shipping and shipbuilding might not individually warrant Federal support of these industries, the collective value of these benefits is substantial and represents a major offset against the cost to the Nation of maintaining the essential maritime resources needed for security purposes. Hence, it is not surprising that the political and economic benefits of a viable merchant marine continue to receive prominent attention in the promulgation and implementation of Federal maritime promotional policies as programs are sought which minimize the net cost to the Nation of maintaining this essential national resource.

Over the years, Federal maritime assistance has been provided in many forms through programs of both direct and indirect aid. Using the Federal subsidy classification scheme developed by the Joint Economic Committee of the Congress,[45] it is possible to identify past or present maritime assistance programs that fall into each of the six Government aid categories described by that Committee. *Direct cash payments* in the form of ship construction and ship operating subsidies have been a mainstay of Federal support since 1936. *Tax assistance* is provided through special provisions allowing tax deferral on income set aside for new ship construction. *Credit aid* has been provided in the form of direct

[44] Message from the President of the United States, House Doc. 118, 74th Congress, 1st Session (1935), p. 31.

[45] U.S. Congress, Joint Economic Committee, Federal Subsidy Programs. A staff study prepared for the use of The Subcommittee on Priorities and Economy in Government. Washington, D.C., Government Printing Office, 1974, p. 1.

Government loans for ship construction and through Federal loan guarantee programs. After major wars, Federally-owned vessels have been provided to private operators at bargain prices yielding a form of Federal aid identified by the Joint Economic Committee as a *benefit-in-kind* subsidy. Discriminatory duties on foreign-built vessels during our early history and the restriction of domestic waterborne commerce to carriage only by vessels registered and built in the United States are two examples of *regulatory subsidies* which have been provided. And finally, *purchase subsidies,* which accrue when the Government buys goods and services at higher prices than necessary, have been made available through Government mail contracts and through U.S.-flag preference requirements associated with the transportation of Government-sponsored cargoes.

Thus, while the motivations for Federal assistance to the merchant marine have been numerous and varied, so have the programs through which such aid has been administered. In the rest of this section many of these programs and activities are described in greater detail in the context of their historical development.

Maritime Aid Before 1936[46]

For much of the first century of our history, Federal aid to U.S. shipping and shipbuilding was confined primarily to indirect assistance provided through such devices as discriminatory duties on foreign-flag vessels and restrictions on U.S. registry and trade participation eligibility. In 1789, for example, legislation was enacted limiting U.S. registry exclusively to vessels built in U.S. shipyards. This law, which was originally designed to protect the infant U.S. shipbuilding industry, remained in force for well over one hundred years before it was repealed in 1912.

To aid the emerging ship operating industry in the early period, discriminatory tonnage duties were imposed on all foreign vessels engaged in the U.S. coastal trades. This form of limited domestic trade protection continued into the early 1800s, but it was soon supplanted by more restrictive legislation enacted in 1808, which, for the first time, excluded foreign vessels altogether from participation in the carriage of U.S. coastal commerce. Cabotage laws reserving U.S. domestic commerce exclusively for vessels built in the United States and operated under U.S. registry have since been a consistent feature of U.S. shipping policy, although it was not until 1920 that the noncontiguous domestic trades were included in these restrictions. Under the terms of Section 27 of the Merchant Marine Act of 1920, trade between the United States and its offshore territories and possessions (except trade with the Virgin Islands) was also reserved for vessels built in the United States and operated under U.S. flag. The 1920 Act, commonly referred to as the Jones Act, is the legislative authority for contemporary cabotage restrictions.

Before the Civil War, cabotage and U.S. registry restrictions were the primary forms of Federal aid provided to the U.S. merchant marine, and, under these limited protections, the U.S. shipping and shipbuilding industries grew and prospered. During the first half of the 19th century, the United States attained a position of great prominence in shipping which reached its peak with the introduction of the famous clipper ships in the 1840s. But in the aftermath of the Civil War the U.S. position rapidly deteriorated with the conversion from sail to steam.

During the war, many U.S. merchant vessels were lost in action and many more were transferred to foreign registry by their owners in order to avoid involvement in the hostilities. Together these occurrences substantially diminished the U.S. merchant fleet and, after the war, inflated U.S. prices and high taxes seriously hampered U.S. fleet recovery. In this same period England attained a substantial technological lead in steamship development. The ready availability of abundant coal close to the sea and the availability of a substantial pool of skilled iron workers provided Great Britain with unique advantages as merchant shipping entered the steam age. Although it had been the U.S. vessel *Savannah* which had made the first steam crossing of the Atlantic in 1819, England attained clear superiority in steam propulsion by mid-century, building iron and steel-hulled steam-powered vessels and replacing paddlewheels with more efficient screw propellers.

To counter the U.S. shipping decline following the Civil War, a new federal subsidy program was inaugurated that authorized several U.S. lines to be operated under Government contract. The program soon collapsed, however, when it was learned that one of the major Government contract holders had expended large sums in lobbying for higher contract payments. Although bribery was never proved, the distaste for direct Federal assistance to the shipping industry persisted for many years after the 1872 scandal.[47]

By the turn of the century, U.S. shipping had slipped to the point where ships of American registry

[46] Samuel A. Lawrence. *United States Merchant Marine Policies and Politics.* Washington, D.C., The Brookings Institution, 1966. This source has been used extensively in developing materials for this section and many of those which follow. In many respects much of the material presented here constitutes a summary of the detailed account presented by Lawrence of the history of U.S. shipping policy.

[47] Ibid., p. 35.

were carrying less than 10 percent of our foreign commerce and only one U.S. trans-Atlantic line remained in operation. During this period, three events focused sharp public attention on the need to revive the U.S. merchant marine.[48]

First, in 1898 during the Spanish-American War, the U.S. Navy found itself heavily dependent, at several critical points, on foreign merchant support vessels. This U.S. fleet deficiency imposed particular hardships on Naval operations in the Philippines and in maintenance of the Cuban blockade.

Following the Spanish-American War the peacetime commercial adequacy of the U.S. fleet was also found seriously wanting when, during the Boer War from 1899 to 1902, many British vessels were withdrawn from U.S. service in order to support the British war effort. Shipping rates escalated rapidly in the U.S. trades and the quality of service plummeted. As a consequence, U.S. exports suffered major setbacks in world markets.

Finally, the voyage of the Great White Fleet in 1907 and 1908 provided a highly visible expression of both our naval strength and our maritime weakness. Intended as a demonstration of U.S. seapower, the 14-month voyage of 16 first-line U.S. battleships and other naval vessels was significantly blemished when sufficient auxiliary shipping to support the voyage could not be secured from the U.S. merchant fleet. As a result the Great White Fleet became dependent for its support on ". . . a motley array of colliers, tankers and tenders bearing the flags of the world." [49]

These three events provided fresh impetus for a thorough reconsideration of the appropriate Federal role in the promotion and protection of the U.S. merchant marine, and a lively public debate ensued regarding what the Government could or should do to improve the maritime situation. The focus of this debate quickly centered on one major issue—free trade versus protectionism.

Essentially "free trade" Democrats urged removal of the 1789 restriction against U.S. registry of lower cost foreign-built ships whereas "protectionist" Republicans wanted to retain the protection afforded to the shipbuilding industry under the 1789 law and provide the U.S. operating industry with direct Federal subsidy assistance. Ultimately it was the free trade position which prevailed, and in 1912, through a provision included in the first Panana Canal Act, duty-free importation of foreign-built vessels for use in U.S. foreign commerce was authorized and duties were removed from materials imported for shipbuilding, outfitting, and repair. Unfortunately, this liberalization of U.S. import policies was soon found insufficient to improve appreciably the condition of the U.S. merchant marine. Higher U.S. crew costs,[50] the cost of registry transfer, and the absence of any real advantage to U.S.-flag operation continued as major impediments to U.S. fleet expansion.

In 1913, the Congress attempted to rectify this situation by including a provision in the Underwood Tariff Act allowing a 5 percent tariff reduction on dutied goods imported aboard U.S.-flag vessels. Although this program proved to be a major aid to U.S. shipping, it was subsequently struck down by the Supreme Court. In its 1915 decision, the Court ruled that the program conflicted with U.S. treaty obligations, citing language in the Underwood Act itself requiring U.S. treaty compliance.

By the time World War I began in Europe, the U.S. fleet had declined to the point where its presence in the carriage of U.S. foreign commerce was virtually nil. As a consequence, after the war began, the withdrawal of European-registered vessels from the U.S. trades left the United States in a critical position. Two immediate steps were taken to ease this situation. First, legislation was passed authorizing the Government to issue war risk insurance covering U.S.-owned merchant vessels in order to allow such vessels to continue operating under wartime conditions. And second, legislation was enacted liberalizing the terms under which U.S.-owned, foreign-flag vessels could be transferred to U.S. registry.

Although these two actions yielded immediate results, it was soon evident that these initiatives would not produce all of the tonnage needed to meet U.S. commercial requirements. As a result, the Wilson Administration initiated a drive for additional legislation to authorize Government acquisition and operation of the merchant fleet. This initiative was delayed in the Congress, however, and it was not until 1916, with enactment of the Shipping Act, that this program was finally authorized. Although the program embodied in the Shipping Act of 1916 was designed to provide merchant shipping to meet commercial requirements, implementation of the new Government program had not really begun by the time the United States entered the war in April 1917. Consequently, the program was quickly converted to an emergency shipping and shipbuilding program in support of the war effort.

As indicated in the previous section of this report, the Shipping Act of 1916 is today most notable for its regulatory provisions. In 1916, however, the focus of attention was clearly on its emergency au-

[48] Samuel A. Lawrence, op. cit. note 46, pp. 33–34.
[49] Ibid., p. 34.

[50] It is interesting to note that the higher U.S. crew costs in this period were not generally traceable to U.S. citizen manning requirements on U.S. registered vessels. In this period, only *watch officers* on ships in the U.S. *domestic trades* were required to be U.S. citizens. It was not until 1915 that the Seamen's Act was passed, becoming the forerunner of subsequent citizenship requirements by requiring that 75 percent of the crew on U.S. ships speak the same language as the ship's officers.

thority. The 1916 Act established a five-member independent Shipping Board with broad promotional, investigatory, regulatory, and administrative powers and authorized the Shipping Board to set up a Government corporation (the Emergency Fleet Corporation) to build and operate merchant vessels. Under this legislation more than 3,000 ships were ultimately authorized for construction although only about one-sixth of these vessels were completed before the end of the war.[51]

The United States emerged from World War I with a merchant fleet representing 22 percent of total world capacity in terms of gross tonnage.[52] This fleet, which had five times the lift capacity of the prewar fleet, was, however, more than half Government-owned, and many of the vessels, hurriedly built under wartime conditions, were ill-suited to peacetime commercial requirements. Because the Shipping Act of 1916 authorized Government ownership and operation of merchant vessels for only 5 years beyond the duration of the war, and because it contained no guidance for disposing of Government-owned shipping capacity, new legislative authority was clearly needed.

Congress responded with enactment of the Merchant Marine Act of 1920. Under the provisions of this legislation, the Shipping Board was directed to determine what shipping lines and services were needed to support U.S. foreign and domestic commerce and to sell or charter Government ships to establish and maintain such services. If necessary, the Shipping Board was also authorized to operate commercial services itself until other suitable private services could be arranged. Furthermore, inexpensive Government loans were authorized in support of new private merchant ship construction. In this period many felt that, given the size of the postwar fleet, sufficient Government promotion, some loan assistance, and, if required, temporary Government operation of commercial vessels, private U.S. operators would have little difficulty in capturing and maintaining a large share of U.S. foreign trade with little additional direct Federal aid. However, almost immediately after enactment of the 1920 Act, the shipping industry entered a major worldwide depression and by 1922, 17 percent of the tonnage in the world fleet lay idle.[53] The inability to sell ships to private operators on satisfactory terms led the Government to undertake commercial operations itself, but large deficits in the program created growing pressure for the Government to dispose of its merchant ships on whatever terms it could get.

In 1928, additional legislation was enacted providing a new form of Federal assistance to U.S.-flag private commercial operators. Under the terms of the Merchant Marine Act of 1928, the Government was authorized to provide private U.S. operators with lucrative mail carriage contracts which were intended to offset the growing differential between U.S. and foreign operating costs. The broad intent of the new program was to encourage U.S. fleet renewal and expansion, and facilitate the disposal of remaining Government-owned vessels. This Act, however, proved difficult to administer and the subsidy value of the mail contracts frequently bore little relationship to actual U.S./foreign shipping cost differentials. Because of numerous controversies among competing applicants for mail contracts, the program failed to facilitate the sale of Government ships and failed to encourage substantial private fleet expansion. Again, the search for a workable Government program began.

In addition to the promotional programs embodied in the Merchant Marine Acts of 1920 and 1928, there was also a minor retreat in the early 1920s from the free import policy which had been adopted as part of the 1912 Panama Canal Act. Under the provisions of the Tariff Act of 1922, the U.S. shipbuilding industry regained a small part of the protection it had lost in 1912 through the imposition of a 50 percent ad valorem duty on all repairs, parts, and equipment purchased abroad for a U.S.-registered vessel. Today this ad valorem duty remains in effect (19 U.S.C. 1466).[54]

The failures of the programs undertaken under the provisions of the Merchant Marine Act of 1928 together with the onset of the depression, precipitated a great deal of criticism, in the early 1930s, of both the substance and administration of U.S. shipping policy. In response to this criticism, under authority which had been provided by the 1933 Independent Officers Appropriations, the President reduced the Shipping Board in size to three members, relieved it of its independent status, and reestablished the Board as a Bureau within the Department of Commerce. At the same time three separate investigations of the mail contract subsidy program were undertaken—one by a select Congressional committee chaired by Senator Hugo Black, a second by the Post Office Department, and a third by the Department of Commerce assisted by an interdepartmental committee of staff experts.

The Black Committee produced the strongest criticisms of the mail subsidy system and called for repeal of the 1928 Merchant Marine Act and complete ces-

[51] Samuel A. Lawrence, op. cit. note 46, p. 40.
[52] Ibid., p. 40.
[53] Ibid., 42.

[54] It is important to note that the Tariff Act of 1922 did not change the duty-free status of foreign-built ships, although, over the years the value of this free import status has been diminished by the provisions of various new government programs. Today foreign-built U.S.-flag vessels are ineligible to receive operating subsidies from the government and, for a period of 3 years, are precluded from participation in the carriage of government preference cargoes.

sation of further aid to U.S. operators. Essentially the position taken by the Black Committee was to urge maximum Government involvement in both the acquisition and operation of a merchant fleet of precisely the size and composition needed to achieve specifically identified national objectives. Although this approach was not adopted in subsequent legislation, many of the specific proposals recommended by Black and his associates for protecting the Government interest were included in the new subsidy program which eventually emerged in 1936.

The Post Office and Commerce reports, while critical of the mail contract subsidy system, urged far less sweeping reforms. The Post Office study basically recommended retention of the existing system with improvement of administrative procedures. The Commerce report emphasized the importance of maintaining a U.S. merchant marine through Government aid, but recommended that future Federal assistance be strictly tied to actual differences between U.S. and foreign construction and operating costs. Upon receiving these reports, President Roosevelt forwarded them to the Congress together with a brief statement expressing his views on the importance of maintaining a viable merchant marine. While the President expressed his support for the abolition of indirect subsidies and for the substitution of some form of more direct construction and operating assistance based on U.S./foreign cost differentials, he left it to Congress to decide how large and what kind of shipping and shipbuilding capacity should be maintained and how it should be owned and operated.

The Merchant Marine Act of 1936

During 1935 and 1936 Congress debated the issue of Government versus private ownership of merchant shipping and focused considerable attention on techniques for maintaining an efficient U.S. foreign trade fleet. Extensive consideration was also given to the technical issue of whether or not it would be possible to determine accurately the parity requirements if a subsidy system based on U.S./foreign cost differentials were adopted. During these deliberations, however, little attention was directed to establishing precise maritime objectives and, as a consequence, when the Merchant Marine Act of 1936 emerged it did not specifically identify the size and kind of merchant marine which was sought through the programs it established.

At the broadest level, the 1936 Act, which remains the primary statutory authority for contemporary Federal subsidy programs, simply reaffirmed and refined the basic national policy of Federal support for a private merchant marine which had been embodied in the Merchant Marine Acts of 1920 and 1928. Paraphrasing Section 101 of the 1936 Act, it declared a national policy of fostering the development and encouraging the maintenance of a merchant marine sufficient to carry the domestic waterborne commerce and a substantial portion of the foreign commerce of the Nation in essential trades; capable of serving as a naval and military auxiliary in time of war; owned and operated insofar as practicable by citizens of the United States; and composed of the best-equipped, safest, and most suitable types of vessels, constructed in the United States and manned by a trained and efficient citizen personnel. Beyond this broad statement of national policy, however, little additional guidance was provided in the law as to the size and type of merchant marine that would be needed to achieve these broad maritime objectives.

Under the provisions of the 1936 Act, new direct construction and operating subsidy programs, based on U.S./foreign cost differentials, were established to replace the mail contract subsidies that were to be phased out in compliance with Title IV of the Act. Through the operating-differential subsidy (ODS) program and the construction-differential subsidy (CDS) program, direct cash payments from the Federal Government were to be provided to qualified applicants to defray the higher cost of building ships in U.S. shipyards and the higher cost of vessel operation under U.S. registry. Although many "free trade" Democrats remained opposed to the provision of direct subsidies to the shipping and shipbuilding industries, the Roosevelt Administration lent its support to the concept, having become convinced that the best way to control maritime aid was to provide it directly, exposing the aid to regular and continuing budget scrutiny.

The new law also established a new agency to administer its provisions and carry out various regulatory responsibilities under the Shipping Act of 1916 and the Intercoastal Shipping Act of 1933. Although Federal regulatory and promotional functions were retained within a single agency, the establishment of a new five-member, bipartisan, independent U.S. Maritime Commission reflected a thorough displeasure by almost everyone with the operation of the Shipping Board Bureau and its predecessor. Hence, the new law sought not only a change of program, but a change in administration as well.

As a compromise to those who favored Government ownership and control of merchant shipping, a separate title (Title VII) was included in the 1936 Act authorizing the Government to build and sell or charter vessels if necessary to achieve the broad objectives of the Act. Furthermore, as indicated previously, many of the protective provisions recommended by Senator Black and his supporters were also incorporated in the legislation.

Under the terms of Title III of the 1936 Act, strict U.S. crewing requirements were imposed on all vessels built or operated with Federal subsidy assistance. All subsidized cargo vessels were required to be manned entirely with native-born or fully naturalized citizens. Some limited noncitizen manning was authorized on subsidized passenger vessels, but only in the steward's department. Citizenship requirements for non-subsidized U.S.-registered vessels were also strengthened in 1936 with enactment of companion legislation requiring licensed officers and pilots on all U.S.-flag vessels to be citizens and requiring 75 percent of the crew on such vessels to be U.S. citizens. Both of these pieces of legislation also included other standards relating to seagoing working conditions, and together these laws greatly expanded Federal responsibility for overseeing conditions of employment aboard all U.S.-registered vessels, particularly subsidized vessels.

As originally drawn, the 1936 Act was primarily devoted to providing Federal aid to the liner segment of the U.S. fleet although it did authorize a study of the need for subsidy assistance for U.S. tramp shipping. Under the terms of the Act, subsidy was to be provided only for vessels operated on routes and in services which the Maritime Commission determined to be essential to the promotion of U.S. foreign commerce. This essential trade route concept, which today remains a major factor in assessing subsidy eligibility for liner vessels, had been first elaborated in the Merchant Marine Act of 1920 in conjunction with efforts to determine where commercial services should be established after World War I.

In addition to the trade route essentiality requirement associated with the new subsidy programs, the 1936 Act also included a variety of other eligibility, monitoring, and reporting requirements which were imposed as a condition for receiving a subsidy. For example, subsidy recipients were required to file detailed reports specifying the nature of their corporate structure, the nature of any interests in foreign-flag shipping, information regarding domestic carriage activities, and other information. Such information was required to assure compliance with restrictions and prohibitions relating to interests held in foreign-flag and domestic trade shipping operations.

Another provision of the 1936 Act precluded the payment of subsidy in support of any service in competition with another U.S. carrier except in cases where service inadequacy could be demonstrated. Another required that all operating subsidy recipients establish capital reserve funds to be used for vessel replacement. Annual contributions to such funds were required. And finally, the 1936 law included subsidy recapture provisions under which certain excess profits from subsidized operation or construction were required to be returned to the Government. For subsidized ship operations the amount required to be recapture was one-half of any profit in excess to be recaptured was one-half of any profit in excess the subsidized operation and, for subsidized construction, one-half of any profit in excess of 10 percent of the construction contract price. The recapture provisions of the construction subsidy program were subsequently supplanted by contract renegotiation procedures established to cover all Government work at a particular shipyard and the recapture provisions of the operating subsidy program were repealed by the Merchant Marine Act of 1970.

In addition to direct subsidy aids provided through the operating-differential subsidy and construction-differential subsidy programs, the 1936 Act included two other indirect assistance programs designed to encourage U.S. fleet expansion. First, earnings set aside in capital reserve funds for new vessel construction were relieved of income tax liability. Second, the Government lending program for ship construction, which had been first authorized under the Merchant Marine Act of 1920, was retained, although new restrictions were included on the allowable interest rates for such loans. This latter provision is a direct lending authority that remains in force, but has not been used for many years. Loan assistance is, today, provided through the Title XI Federal Ship Financing program, the basic authority for which was added to the Merchant Marine Act in 1938.

In recognition of the national security role of the U.S. merchant marine, a variety of defense and security provisions were also incorporated in the 1936 Act. The U.S. Maritime Commission, in approving subsidized vessel designs, was required to coordinate such designs with the Navy. Any special noncommercial national defense features recommended by the Navy were to be included and fully funded by the Maritime Commission. Vessels constructed with subsidy assistance were made subject to repurchase by the Government at cost-less-accumulated-depreciation, and power was provided to requisition other private U.S.-owned vessels under certain national emergency conditions, with provisions included for "just compensation." (In 1954, similar authority to requisition foreign-owned vessels was extended under the provisions of the Emergency Foreign Vessels Acquisition Act.) Finally, under the provisions of Section 503(f) of the Act, the Commission was required to undertake an annual survey of U.S. shipbuilding capacity in coordination with the Navy in order to assure the adequacy of the shipbuilding mobilization base in light of the Nation's security needs.

In implementing the new Merchant Marine Act, the first order of business was to terminate existing claims associated with the mail contract program. Under the terms of Title IV of the Act, a June 30,

1937, deadline had been established for the termination of the mail contract program, and this deadline was met by the new Maritime Commission.

While the mail contracts were being settled, however, a thorough economic assessment of the merchant marine was also being made by the Maritime Commission to serve as the basis for future program execution. Based on the findings of its *Economic Survey of the American Merchant Marine,* which was published in November 1937, the Commission announced its intention to build 50 merchant ships per year over a 10-year period. The announced program was designed simply to maintain existing U.S. fleet capacity through the replacement of obsolete tonnage and was not a fleet expansion program. Because sufficient financing was not available to undertake the desired construction privately, the program was begun under the provisions of Title VII and ships were constructed for Government account.

By the end of 1939, 127 dry cargo vessels had been contracted for under the new 500-ship program, but private buyers had been found for only 38 of these vessels. The success of the operating subsidy program in this period was also limited and, because of these developments, the Government continued to operate several older Government-owned services through charter arrangements with private firms. During this period, the Maritime Commission also established a new Government-sponsored Good Neighbor service to South America.

As indicated previously, a new Title XI was added to the Merchant Marine Act in 1938, which authorized the provision of Federal insurance on eligible ship mortgages as a means of encouraging private capital investment in U.S. ship construction. Over the years this program, which is now the primary program for ship financing and refinancing assistance carried out by the Government, has been revised many times and was completely overhauled in 1972. Today, the Title XI program is a financing guarantee program (rather than a mortgage insurance program) under which the Government guarantees shipbuilding obligations sold to investors. Under the present program, such guarantees may be provided by the Federal Government covering up to 75 percent of the construction cost of vessels built with construction-differential subsidy assistance, and nonsubsidized construction projects may qualify for Federal guarantees of up to 87½ percent of vessel cost. Vessels to be used in both the foreign and domestic trades are eligible for Title XI aid. Today the types of U.S. vessels specifically eligible for mortgage guarantee assistance include: cargo, passenger, and combination ships, tankers, tugs, towboats, barges, dredges, fishing vessels, floating drydocks, and oceanographic research and pollution abatement vessels. Coverage has also been extended by legal interpretation to mobile offshore drilling rigs. Under current arrangements, the National Oceanic and Atmospheric Administration administers the Title XI program with respect to fishing vessels, and the Maritime Administration administers the rest of the program.

The program to build 50 ships per year had just begun to show results when, in August 1939, war began again in Europe. Because of the hostilities, the U.S. merchant ship construction program was rapidly expanded and by the time the United States entered the war about 6 million deadweight tons of shipping had been ordered from U.S. yards and a vessel of simplified design (the Liberty Ship) had been developed for mass production and export to Great Britain.[55]

In 1941 the United States entered the war, and within a year and a half the United States was building ships faster than the enemy could sink them. From 1942 through 1945, U.S. yards produced 5,592 merchant ships and during this period expenditures for merchant ship construction exceeded $12 billion. A work force of 4 million workers was involved in this effort, with 1.7 million employed in the shipyards themselves.

In February 1942 the Government took over direction of ship operations with the establishment of the War Shipping Administration. The Chairman of the Maritime Commission also served as head of this agency, and the two departments worked closely together. The new agency took over the fleets of both domestic and foreign trade operators, purchased foreign ships, and seized enemy shipping. New ways were devised to maximize vessel use, and thousands of merchant seamen were recruited and trained. During the war four-fifths of the supplies for the war effort were carried on ships under the control of the War Shipping Administration.

Maritime Policy After World War II

At the beginning of World War II, only 14 percent of world merchant tonnage was registered under U.S.-flag. The United States emerged from the war with 60 percent of total world capacity. Postwar reconstruction programs imposed heavy demands on merchant shipping capacity, and efforts were begun immediately to restore private control of U.S. shipping. The War Shipping Administration was abolished in September 1946, and its remaining functions were transferred to the Maritime Commission. By the end of 1947 all ships taken over from private interests had been returned to their owners. The great demand for

[55] Samuel A. Lawrence, op. cit. note 46, p. 74.

shipping to carry relief supplies and the inadequacy of private shipping to meet this demand made it necessary to place large numbers of Government-owned ships under charter, but, as conditions improved, this chartering operation declined. By the middle of 1950 fewer than 100 Government-owned vessels remained in the chartering program.

To dispose of the hundreds of Government-owned war-built ships, the Merchant Ship Sales Act was enacted in 1946. This legislation authorized ship sales not only to U.S. citizens, but to our allies as well, as part of the postwar reconstruction effort. When the Merchant Ship Sales Act expired in 1951, 1,956 ships had been sold (843 to U.S. operators and 1,113 to foreign flag operators) at a return of nearly $2 billion to the Government.

Under the terms of Section 11 of the Merchant Ship Sales Act, the Maritime Commission was required to establish and maintain a National Defense Reserve Fleet (NDRF) of Government-owned merchant ships to be used in the event of future national emergencies. Ships for this fleet were selected after consultation with the Secretary of the Navy and were placed in eight anchorages—three each on the East and West Coasts and two on the Gulf Coast. On June 20, 1950, the reserve fleet reached its maximum size of 2,277 ships.

Since establishment of the NDRF, vessels held in the fleet have been activated on several occasions to meet emergency shipping requirements. In the early 1950s, some 300 reserve fleet vessels were reactivated in support of U.N. forces in Korea. At about the same time, a critical commercial shortage of world shipping capacity also developed because of increases in European demand for American coal and the need to transport large quantities of grain to India where a series of natural disasters had severely limited agricultural output.

To reduce the detrimental impact of these commercial shortages, additional ships from the NDRF were activated and devoted to the carriage of grain to India. In January 1952, a peak of 725 NDRF vessels in active service was attained in response to the combination of these commercial requirements and the military support requirements associated with the hostilities in Korea.

Ships from the NDRF were again activated in 1956 when the Egyptian nationalization and closing of the Suez Canal precipitated another worldwide shipping crisis. The need to ship many goods over greater distances resulted in a substantial commercial shipping shortage and forced freight rates rapidly upward. The shortage and higher freight rates placed a major burden on the United States, and, as a consequence, an extensive NDRF reactivation was undertaken. A total of 223 dry cargo ships and 29 tankers were eventually activated in response to this crisis.

The most recent reactivation of vessels from the NDRF was undertaken in support of the war in Vietnam, during which 172 reserve fleet vessels were withdrawn from the fleet and placed in active service under contracts with private operating companies. This operation, which ended in November 1970, was motivated more by commercial considerations, however, than by emergency necessity. By using NDRF vessels instead of commercial ships for this service, U.S.-flag commercial operations were not unduly interrupted. Generally, it was felt that the diversion of U.S.-flag capacity from its usual trading patterns would have significantly damaged commercial operations, because many regular U.S.-flag customers would have been forced to seek alternate services. Once lost, it was felt that such customers would be difficult to recapture and that the long-term cost of this commercial damage would greatly exceed the cost of NDRF reactivation. Increasingly, this NDRF role in protecting U.S. commercial shipping by providing a capacity which may be used during limited emergencies has been cited as a major justification for the continued maintenance of at least some reserve fleet capacity.

During both World Wars American shipowners were provided with Government-sponsored war-risk insurance, but at the end of each war this coverage was discontinued. In 1952, to meet Korean War requirements, a new title XII was added to the Merchant Marine Act of 1936 establishing what has become a more or less permanent war risk insurance authority.

Under this program the Government is authorized to insure or reinsure vessels or other components of the U.S. foreign trade marine transportation system against loss or damage due to war when it is determined that such coverage is not commercially available on reasonable terms, and when it is determined that without such coverage, U.S. waterborne commerce would suffer. Coverage authority extends to both U.S. and foreign flag vessels owned by U.S. citizens and, if necessary, may be extended to foreign-owned foreign-flag vessels engaged in U.S. commerce. This war risk insurance authority includes an expiration date which has been periodically extended by the Congress. The statutory basis of the program lapsed briefly from September 9, 1975, through October 17, 1976, but the current authority runs to September 30, 1979.

The lapse of authority in 1975-76 was due principally to controversy surrounding the availability of this coverage to foreign flag vessels. Many U.S. operators sought an end to this program for foreign vessels. Ultimately, foreign coverage authority was retained but stricter eligibility requirements were imposed to assure that such vessels are needed to meet national security requirements. In addition, vessel location reporting requirements were imposed on all foreign vessels included in the program.

Following the Korean hostilities, there was a

dramatic decline in the demand for tramp shipping and, as a consequence, pressures began to emerge for a greater reservation of Government cargoes for private U.S.-flag vessels to aid this segment of the U.S. fleet. Although prior to 1954 a number of laws had been enacted which contained U.S. preference provisions for various Government cargoes, legislation was now sought which would yield a more comprehensive preference program covering all Government-sponsored cargoes. The result of this effort was enactment, in 1954, of a new preference statute as an amendment to the Merchant Marine Act of 1936. Under this program, 50 percent of virtually all Government-sponsored shipments must now be made aboard private U.S.-flag vessels to the extent such vessels are available at fair and reasonable freight rates.

Two of the pre-1954 preference programs, still retain special significance, because they impose preference requirements beyond those contained in the 1954 law. Under the Military Transportation Act of 1904 *all* supplies moved by sea for the U.S. armed forces must be carried by U.S. vessels if freight rates are not ". . . excessive or otherwise unreasonable." However, since this law does not specify that such carriage be performed by private vessels, compliance before 1954 could be achieved by carriage exclusively aboard government-owned vessels. The joint application today of both the 1904 and 1954 preference statutes means that 100 percent of military cargoes must be carried aboard U.S. vessels and that 50 percent of this requirement must be met by carriage aboard vessels owned by private operators.

The second pre-1954 preference program still in effect stems from Public Resolution 17, which was passed in 1934 and expressed "the sense of Congress" that cargoes exported from the United States as a result of loans made to foreign purchasers should be shipped exclusively in U.S. vessels if available at reasonable rates. After World War II, as a part of the U.S. reconstruction program, a general policy was adopted under which a waiver of up to 50 percent of the U.S. carriage reservation would be granted in favor of vessels of the recipient nation if that nation did not discriminate against U.S. vessels in its foreign trade. This policy remains in effect, and foreign recipients of Export-Import Bank credits regularly apply to the Maritime Administration for such "general waivers."

In 1961 an amendment to the 1954 Cargo Preference Act was passed which raised an important barrier to the redocumentation of foreign vessels in the United States. Under the terms of this amendment, foreign vessels transferred to U.S. registry are excluded for a period of 3 years from participation in the preference trade established by the 1954 Act. Hence, while foreign vessels may still be imported on a duty-free basis, they are precluded for 3 years from carrying the preference cargoes upon which many non-subsidized U.S. vessels are heavily dependent. (Such foreign-built vessels, of course, are also ineligible for operating subsidy as well as for participation in the carriage of U.S. domestic commerce.)

Ultimate responsibility for compliance with U.S. cargo preference laws extends directly to each individual Government agency, although the U.S. Maritime Commission and its successors have served as general coordinators of this program. Today, the Maritime Administration is authorized to establish administrative provisions governing cargo preference implementation with which shipper agencies must comply.

Since the cargo preference statutes require only that the preference share be carried by U.S.-registered vessels, it has frequently been argued that when *subsidized* U.S. vessels carry these cargoes they are in effect receiving a "double subsidy." In 1970, this issue was addressed by the Maritime Subsidy Board under Docket S-244. As a result of its ruling in this case, which was subsequently sustained on appeal, the Subsidy Board established a procedure for operating subsidy reduction in cases where subsidized *liner* operators become excessively dependent on preference cargoes. Under this ruling liner recipients of operating differential subsidy (ODS) are allowed to participate in the carriage of preference cargoes with no reduction of ODS so long as receipts from this preference carriage do not exceed 50 percent of total revenues. If they should exceed 50 percent of total revenues, ODS is reduced by a percentage that is tied to the amount of revenue in excess of the 50 percent ceiling.

Although the 1970 ruling pertained only to *liner* operations, bulk carriers, which today receive ODS under the provisions of the Merchant Marine Act of 1970, are generally precluded, under the terms of their subsidy contracts, from participating in the carriage of the preference share of preference shipments. They are, however, free to compete with all other carriers (both U.S. and foreign) for carriage of the non-preference share of such cargoes. It should be noted that there are currently no restrictions with respect to the carriage of preference cargoes imposed on any U.S. vessels that have been built with construction-differential subsidy.

Before World War II and in the early postwar period, the Government did not hesitate to use the provisions of Title VII of the Merchant Marine Act to build and sell or charter vessels in order to accomplish the purposes of the 1936 Act. In the postwar period, the most significant title VII construction program was the program begun in 1951 under which 35 "Mariner" class vessels were built for Government account. These 20-knot, 13,000-ton, general cargo ships were specifically designed to be highly adaptable to military use in the event of a national emergency. Ultimately, 29 of these vessels

were sold to private operators, 5 were assigned to the Navy, and 1 was lost at sea. Except for the contract to construct the nuclear ship *Savannah,* no construction has been initiated under Title VII authority since 1953 when the last of the Mariner construction contracts was signed.

In the years following World War II, three different Federal organizational structures have existed for carrying out U.S. shipping policy. As noted previously, upon abolition of the War Shipping Administration in 1946, administrative, promotional, and regulatory responsibilities in this area were returned to the U.S. Maritime Commission. Although this had been the arrangement of these functions before the war, dissatisfaction with the intermingling of these responsibilities soon emerged in the postwar period, and in 1950 the President's Reorganization Plan No. 21 abolished the U.S. Maritime Commission.

In place of the independent Maritime Commission, two new agencies were established and located in the Department of Commerce. A three-member Federal Maritime Board was constituted to carry out all Federal regulatory functions and certain quasi-judicial functions associated with the rendering of subsidy determinations, and a Maritime Administration was established to carry out the administrative requirements associated with the implementation of various merchant marine promotional programs. Under this arrangement, the Chairman of the Federal Maritime Board also served as ex-officio Administrator of the Maritime Administration and the two bodies were served by a common staff. When functioning in a regulatory capacity, the Board was to be independent of the Secretary of Commerce, but, in its quasi-judicial subsidy role, it was to be guided by promotional policies established by the Secretary. The Maritime Administration discharged its responsibilities strictly in compliance with Department of Commerce authority.

Although this basic structure was retained throughout the 1950s, it became an increasingly confusing and cumbersome arrangement the longer it remained in effect. As Lawrence has noted in his discussion of this period, things had become so confused by 1959 that the Chairman/Administrator of the Federal Maritime Board — Maritime Administration had adopted the practice of signing all documents in both official capacities so that his actions could not be challenged for having been taken under the wrong authority.[56]

In 1961 Presidential action was again taken in an attempt to rectify these organizational difficulties. Under Presidential Reorganization Plan 7, the Federal Maritime Board was abolished and its regulatory functions transferred to a new independent five-member Federal Maritime Commission. The Maritime Administration was retained within the Department of Commerce, and to its other responsibilities were added the subsidy determination functions previously exercised by the Federal Maritime Board. Subsidy rulings under this arrangement were to be discharged by a Maritime Subsidy Board consisting of the Maritime Administrator, the Deputy Maritime Administrator, and the Maritime Administration General Counsel.

The organizational structure established in 1961 for the first time completely separated the promotional and regulatory functions of the Federal Government and placed them in totally separate agencies. This structure has been retained since 1961.

The Merchant Marine Act of 1970

Because of the large number of Government-owned ships sold to private operators after World War II, few new ships were constructed in the United States in the postwar period and during the 1950s and 1960s the U.S.-flag merchant fleet declined rapidly. In 1950, U.S.-flag vessels carried more than 40 percent of the country's total foreign commerce; by 1969 this figure had declined to about 5 percent, and three quarters of the vessels in the U.S. fleet were more than 20 years old and economically obsolete. Although a few new ships were added to the fleet each year, these were primarily breakbulk vessels and total construction under the subsidy program in this period was limited.

In an effort to reverse the decline of the 1950s and 1960s, and to provide incentives for expansion of the U.S. bulk fleet, a comprehensive overhaul of the Merchant Marine Act of 1936 was undertaken. On October 21, 1970, the President signed into law the amendments to the 1936 Act, which are known collectively as the Merchant Marine Act of 1970.

At the broadest level, enactment of the Merchant Marine Act of 1970 represented a general reaffirmation of the national policy of Federal support for the U.S. merchant marine. Although the 1970 act implemented a number of major program adjustments designed to increase the effectiveness of the Merchant Marine Act of 1936, the fundamental policies embodied in the 1936 Act emerged essentially unaltered. The commitment to maintain a viable U.S. merchant marine was reiterated, and the major programs of Federal aid, although modified, were retained. Direct construction and operating subsidies remained central to the U.S. Federal assistance program, and additional aid was continued through such programs as construction fund tax deferment

[56] Samuel A. Lawrence, op. cit. note 46, p. 257.

privileges, Federal mortgage guarantees, and cargo preference for Government-sponsored cargoes.

The Merchant Marine Act of 1970 did not institute any truly fundamental changes in U.S. maritime policy, but it did include numerous major program changes that were intended to completely modernize Federal maritime assistance programs. These changes emerged after months of study by the Administration and after extensive hearings before the Congress. The changes were based on a synoptic review of existing Government maritime policies and programs. Hence, the 1970 Act, while not a new policy initiative, constituted a comprehensive refinement of Federal maritime assistance activities. Many of the program changes adopted in 1970 remain intact, and, in the paragraphs below, the most important of the changes implemented will be briefly discussed.

In seeking ways to revitalize the declining U.S. merchant marine, a common view emerged early in the process that, regardless of the specific types of Government aid used to support the revitalization effort, an essential ingredient required for success would be a firm and explicit long-term Government commitment to the task. As a consequence, when the 1970 Act was passed, it included a specific pledge of Government support for a 10-year, 300-ship construction program to be undertaken with Government-provided construction-differential subsidies. This commitment, which was incorporated in Section 209 of the Merchant Marine Act, included authorization to appropriate funds needed to achieve this construction objective. The basic purpose of this commitment was to encourage investment in and modernization of U.S. shipbuilding facilities in order to improve U.S. shipbuilding productivity and thereby reduce U.S.-foreign construction cost differentials and subsidy dependence.

Another construction-related initiative incorporated in the 1970 Act was the authorization it provided to grant construction-differential subsidies (CDS) directly to shipyards rather than limiting CDS eligibility to ship purchasers only. This change was designed to encourage greater shipyard participation in vessel design. It was felt that shipyards would be able to influence designs in ways that would ease construction, lower building costs, and increase shipyard productivity.

Negotiated contracting between shipyard and purchaser, as an alternative to competitive bidding, was also authorized under the 1970 Act insofar as certain conditions could be met. The negotiated contract procedures were included to help reduce shipbuilding costs by eliminating expenses associated with bid preparation and as a means of encouraging shipyards to develop and market standard vessel designs. To take advantage of the negotiated contracting procedure, the purchaser and builder were required to submit backup cost data to demonstrate the reasonableness of the price; the Secretary of Commerce was required to determine that the price was fair and reasonable; and the shipyard was required to agree to be audited by the U.S. Comptroller General. As an additional requirement, the Act specified special declining construction-differential subsidy rate ceilings which could not be exceeded in conjuntion with any negotiated CDS contract.

Declining CDS rates (which were the same as those imposed as a condition of negotiated procurement) were also specified as objectives for all CDS awards regardless of the type of contracting procedure used. These goals called for a maximum CDS rate of 45 percent in fiscal year 1971 and a reduction of this ceiling by 2 percentage points in each subsequent fiscal year until a level of 35 percent was achieved for fiscal year 1976. After 1976 the 35 percent CDS ceiling objective was to be retained. If at any time it was determined that these specific annual objectives could not be met, the Secretary of Commerce was authorized to negotiate with bidders in an effort to come as close to the objectives for the period as possible. Hence, while the CDS rate objectives embodied in the 1970 Act constituted legal requirements for the purposes of negotiated procurement, these ceiling rates were objectives with respect to CDS paid in conjunction with competitive procurement. Nonetheless, the 1970 Act made it clear that these goals were to be actively pursued for all CDS contracts.

To encourage the construction and operation of badly needed bulk carriers, the Merchant Marine Act of 1970 included a number of provisions which were specifically aimed at aiding the bulk segment of the U.S. merchant fleet. Although the construction subsidy provisions of the Merchant Marine Act of 1936 had been revised in 1952 to authorize CDS for bulk carriers, by 1970 no bulk vessels had been built under these provisions. Consequently, further changes were enacted in 1970 to provide additional government encouragement for bulk fleet expansion.

Among the bulk shipping provisions of the Act, the one which implemented the most fundamental change was the provision extending operating-differential subsidy eligibility to U.S.-built tankers and dry bulk carriers. This was the first time such vessels had been authorized to receive operating aid. In addition, subsidy eligibility restrictions pertaining to U.S. companies or individuals who also owned foreign shipping were liberalized with respect to bulk shipping operations in order to allow such owners to systematically replace foreign tonnage with new U.S. capacity. Finally, limits on foreign-to-foreign trading were liberalized for subsidized bulkers in recognition that the nature of the bulk shipping industry was distinct from the liner industry. Together with the availability of Title XI mortgage guarantees and a 10-year Government commitment to fleet expansion, it

was felt that these changes would, for the first time, make the construction subsidy provisions of the Act responsive to the needs of bulk shipping operators as well as liner operators.

In an effort to keep operating subsidies to a minimum and encourage effective collective bargaining by ODS recipients, the 1970 Act revised the wage subsidy provisions of the Merchant Marine Act by tying subsidizable U.S. wage expenses to a general U.S. wage index. Under this system, wage increases in excess of the amount allowed by the index were no longer authorized for subsidy, and wage levels which were kept below the index level would yield extra subsidy income for the operator. A limit was placed on the extent to which true wage costs could vary from the index-based "subsidizable wage cost," and every few years (not less than two or more than four) a new base period was to be established at which time actual wage rates would be used as a new starting point for subsequent years. Through this program ODS operators were given important incentives to keep subsidizable wage cost increases to a minimum.

The 1970 Act extended eligibility to establish tax deferred Capital Construction Funds, under the terms of Section 607 of the Merchant Marine Act, to virtually all U.S. vessel operators. Before 1970, this program was available only to ODS recipients. Although all U.S. operators can now establish such funds, the use to which these funds may be put is limited. Such tax deferred funds may be used only for the construction or reconstruction of vessels for use in U.S. foreign commerce, for use on the Great Lakes or in the non-contiguous domestic trades, or for use in the fisheries of the United States. Hence, these funds may not be used for the construction of vessels for the inland and intercoastal domestic trades.

Similar, although much more limited, tax deferral benefits are available, however, through the Construction Reserve Fund program (Section 511), which does not preclude the construction of vessels intended for inland and intercoastal domestic service. Basically, this program allows any U.S. operator to establish a fund into which gains on the sale or other disposition of a vessel may be deposited on a tax-deferred basis. However, this program does not allow other tax-deferred deposits (such as earnings) so it is generally used only for accumulating funds to construct vessels ineligible for the Capital Construction Fund Program.

Under the Merchant Marine Act of 1970, the operating subsidy recapture provisions of the 1936 Act were repealed. As indicated previously, subsidized operators before 1970 were required to pay to the government one-half of profits (averaged over a 10-year period) in excess of 10 percent on capital necessarily employed in subsidized operations up to the amount of subsidy actually received. Elimination of recapture was justified principally because much the same function was now performed by higher corporate tax rates and over the years the program had become expensive and difficult to administer.

In addition to the major program elements discussed above, the 1970 Act also contained numerous other provisions affecting various maritime promotion programs and their administration. The ceiling on the amount of outstanding debt which could be guaranteed under Title XI was raised from $1 billion to $3 billion. (Subsequent amendments have increased this ceiling to a current level of $7 billion.) The 1970 Act established a Commission on American Shipbuilding to study the U.S. commercial shipbuilding industry and report within 3 years. A new position of Assistant Secretary for Maritime Affairs was established in the Department of Commerce, although the new position was required to be occupied by the same person who serves as Maritime Administrator. The Act included a provision requiring agencies subject to cargo preference to administer their preference responsibilities in accordance with regulations promulgated by the Secretary of Commerce. And finally, the 1970 Act specifically identified the Great Lakes as a fourth seacoast and required that it be given equitable treatment under the Merchant Marine Act with respect to its foreign trade requirements.

These were the major provisions of the Merchant Marine Act of 1970, which were intended to provide the legislative foundation for a 10-year program of U.S. maritime renewal. In the next section a number of other general support activities carried out by the Maritime Administration will be discussed and the following section will describe progress achieved to date under the terms of the 1970 Act and the program deficiences which have emerged.

General Federal Maritime Support Activities

Beyond the specific shipping and shipbuilding aid programs carried out by the Maritime Administration, a number of additional general support activities are conducted which are designed to further overall U.S. maritime policy objectives and provide support for other broad national goals. Included in this category are programs in such areas as research and development, maritime manpower, market development, environmental protection, and national security. Brief consideration will be given to the major developments in these areas since 1970.

Over the years, programs sponsored or conducted directly by the Maritime Administration and its predecessors have spawned major technological ad-

vances in marine transportation. It has been estimated that various provisions of the Merchant Marine Act of 1936 have been responsible in whole or in part for the production of about 9,150 vessels.[57] In the course of this massive effort, the Maritime Administration and its predecessors have consistently been in the forefront of naval architecture and marine engineering and have contributed materially to the advancement of these disciplines. In World War II these capabilities were directed to the mass production of merchant vessels of simplified standard design in support of the war effort in the largest ship construction program ever undertaken. And in peacetime these talents have been directed to the task of keeping U.S. construction and operating costs as low as possible while at the same time setting high standards for the shipping and shipbuilding industries.

In recognition of the importance of U.S. technological development to the success of the 1970 maritime program, Maritime Administration research and development activities were expanded. One of the prominent objectives of the program begun in 1970 was to increase the relative efficiency of U.S. shipping and shipbuilding in order to diminish the dependence of these industries on Federal assistance. In pursuit of this goal, the Maritime Administration research and development program was significantly enlarged and redirected to emphasize short-term development projects with early application potential. This expanded Government-sponsored R&D effort has been of particular importance to the U.S. shipping and shipbuilding industries, inasmuch as limited profitability has tended to minimize the resources available within the industries themselves for R&D activities. This program has made possible many research projects aimed at improving the competitive position of the U.S. merchant marine, which could not otherwise have been undertaken. While MarAd R&D budgets averaged $6 to $7 million per year in the late 1960s, budgets from 1971 through 1976 averaged between $20 and $25 million per year.

To increase the likelihood that research and development results will be directed to meet industry needs and subsequently adopted, industry participation in planning and carrying out research projects has been actively encouraged. As a consequence of this effort, the present MarAd R&D program is characterized by substantial industry participation and cost sharing. From the beginning of fiscal year 1971 through the end of fiscal year 1976, funds authorized by Congress for MarAd R&D totaled about $127 million. Additional industry contributions to MarAd-sponsored R&D projects over this period were about $62.3 million, bringing the total program to about $189.3 million for the 6-year period. It should be noted that the industry cost-sharing percentage has grown over the past 3 years.

Analyzing the 760 research and development projects undertaken since the beginning of fiscal year 1971, the Maritime Administration estimates that these projects have already returned at least $84 million worth of benefits. Over the next 10 years, MarAd estimates that the net present value of economic benefits expected to accrue from these same projects could aggregate more than $2 billion.

To increase U.S.-flag foreign trade carriage and increase the use and efficiency of U.S. marine transportation services, the Maritime Administration conducts a vigorous marketing program on behalf of all U.S.-flag operators. Essentially, this program consists of two elements. First, extensive marketing information and cargo data are maintained by the agency for use by U.S. operators in support of their individual marketing efforts. And second, a major promotional program is conducted by the agency itself to familiarize shippers with the advantages of transporting their cargoes on U.S.-flag vessels. In support of this second component of the program, MarAd marketing representatives visit shippers and shipper associations around the country to promote patronage of U.S. carriers.

Another marketing initiative with which the Maritime Administration has been extensively involved is the National Maritime Council (NMC), which was established in 1971 to develop and encourage industry cooperation in the promotion of the U.S. merchant marine. Providing a forum for the exchange of ideas and information, and the presentation of opinions and problems, NMC has proven extremely successful in maintaining intra-industry harmony in pursuit of common goals. Today, NMC consists of 33 member organizations representing all aspects of the maritime industry. MarAd's Office of Market Development serves as Executive Secretariat. The cooperative spirit engendered by NMC is given a large share of credit by MarAd for the stable labor-management relations which have prevailed in the industry since 1970.

Under the auspices of MarAd's market development program, a major national conference was held in 1976 at Hyannis, Mass., to consider the special problems which have impeded expansion of the U.S. fleet in the carriage of dry bulk commodities. Despite increased Federal support available under the 1970 Act, this segment of the fleet has continued to decline, and, today, U.S. participation in this area stands at less than 2 percent of the total U.S. foreign trade in dry bulk commodities. The Hyannis Conference brought together bulk shippers and leaders representing all segments of the maritime industry in

[57] E. Scott Dillon, Ludwig C. Hoffman, and Donald P. Roseman. "Forty Years of Ship Design Under the Merchant Marine Act, 1936–1976." Paper presented before the Annual Meeting of the Society of Naval Architects and Marine Engineers, New York, November 11–13, 1976, p. 2.

an effort to identify specific impediments to U.S.-flag expansion in the bulk trades, to recommend initiatives to improve performance in this area, and to make known to those not fully familiar with the U.S. maritime program the aids already available to bulk shipping. The conference generated 36 recommendations, which have led to several administrative actions to improve the MarAd bulk shipping effort. In addition, a package of legislative proposal relating to bulk shipping is being developed.

To assure the availability of a well-trained workforce for the U.S. merchant marine, the Maritime Administration conducts a number of programs for manpower training and development. In addition, MarAd assists in labor-management negotiations, serving as a neutral source of information for both labor and management, in an effort to facilitate the peaceful settlement of disputes and avoid disruptive strikes.[58]

Under the provisions of Section 216 of the Merchant Marine Act, the Maritime Administration maintains the U.S. Merchant Marine Academy at Kings Point, N.Y., which provides students with a college education and the training necessary to assume positions as officers in the merchant marine upon graduation. In addition, Federal assistance is also provided to support training for merchant marine officers at six State maritime schools. Authority for this program is contained in the Maritime Academy Act of 1958.

Beyond these officer training assistance programs, the Maritime Administration also supports several other marine training activities. Five radar training centers are operated around the country under joint MarAd-Coast Guard sponsorship and are available for use by qualified merchant seamen, inland waterway, offshore drilling, and mining vessel operators, maritime academy students, and NOAA and Coast Guard personnel. Firefighting and fire damage control courses are given by MarAd and the Navy's Military SeaLift Command. And finally, the recently opened Computer-Aided Operations Research Facility (CAORF)[59] at Kings Point, although primarily a research facility, is expected to yield substantial auxiliary training benefits to the ship operating industry.

In conjunction with the developing trade between the United States and the Soviet Union, the Maritime Administration has played a major role in negotiating and implementing the shipping agreements governing these trades. On October 14, 1972, U.S. and Soviet officials signed a major 3-year maritime agreement which provided a general framework and established a set of ground rules governing maritime relations between the two nations. Modified and extended for another 6 years in 1975, the objectives of both the original and extended agreement were to open the channels of maritime commerce between the two nations by opening major U.S. and Soviet commercial ports to specified kinds of U.S. and Soviet-flag vessels and to provide vessels of each country with an opportunity to participate equally and substantially in the carriage of all waterborne cargoes moving between the two nations. In defining the substantial share of cargoes to be carried by the vessels of the Soviet Union and the United States, the agreement sets forth the intention of each country to provide its vessels with an opportunity to carry not less than one-third of all cargoes moving in the trade. The remainder of the trade is available to vessels of other flags.

In implementing this agreement, bulk carriage freight rates for the U.S.-flag share of agricultural cargoes exported from the United States to the Soviet Union have been periodically renegotiated to assure that U.S. vessels carry the one-third share allotted to them at charter rates which provide a reasonable return to the U.S. operator (after receipt of operating subsidy), but which do not impede U.S. grain sales. Essentially, U.S. negotiators have sought rates equivalent to those which would have to be obtained by foreign carriers in order to continue long-term profitable operations. When an operating differential subsidy, paid by the U.S. Government, is added to this revenue to offset the U.S./foreign cost differential, the U.S. operator is assured an opportunity for profitable participation. At the same time, the Soviet Union pays a reasonable price for the shipping service.

During periods when grain exports to the Soviet Union are large, this trade can provide a major source of employment for U.S.-flag bulk carriers. As a primary participant in negotiations relating to the terms governing shipping services in this trade, the Maritime Administration helps assure that U.S. operators have a fair chance to take full advantage of this important trade opportunity.

In support of its national security mission, the Maritime Administration maintains the National Defense Reserve Fleet and carries out a variety of planning and readiness functions designed to assure the adequacy and timely availability of shipping and shipbuilding resources in the event of war or other national emergency. Over the years, the number of ships maintained in the reserve fleet has declined dramatically and, as of June 20, 1977, the NDRF

[58] A principal service provided by MarAd during labor-management negotiations is access, by all parties, to the computer-based Maritime Contract Impact System (MCIS) which provides rapid calculation and evaluation of the impact of changes in base wages and fringe benefits.

[59] CAORF, developed and operated under the MarAd research and development program, provides a full-scale mockup of a vessel bridge with computer equipment designed to simulate the operating characteristics of various vessels under a wide variety of operating conditions. This facility is designed principally as a research tool to test and analyze new operating procedures, port configurations, and equipment, and to assess human reactions under various normal and abnormal operating conditions.

consisted of 344 Navy and MarAd vessels held in three reserve fleet sites. The number of retention ships in the fleet (vessels which receive conventional preservation treatment, dehumidification, and cathodic protection) now stands at 216, of which 149 are MarAd vessels and 67 are Navy-owned. The remaining ships in the NDRF are either scrap candidates or designated for special programs.

As indicated previously, a major role now cited for the NDRF is to provide the United States with a surge capability in order to minimize the disruption to regular U.S. commercial carriers in a limited national emergency. To improve the responsiveness of the NDRF to meet such requirements, a program was recently undertaken to place about 30 NDRF vessels in a special ready-reserve status that would permit activation in as little as 5 to 10 days. So far, seven vessels have been placed in ready reserve status and one additional vessel is now being modified for the program.

The Maritime Administration also coordinates with the Navy Department through the Navy Sealift Readiness Program (SRP). Under this program, carriers in the regularly scheduled berthline trades who wish to carry Department of Defense preference cargoes in peacetime must commit half of their shipping capacity to military support operations in the event of a nonmobilization emergency. Because they are fully operational in peacetime, SRP vessels can be made available more quickly in an emergency than most of the vessels in the Reserve Fleet. MarAd works closely with the Navy on this program to assure that the shipping capacity to meet emergency requirements will be available when needed, while at the same time assuring that the negative commercial impact is minimized.

Until July 1, 1977, the Sealift Readiness Program required vessel callup for a minimum of 6 months and a maximum of 12 months. Because a 6-month diversion from normal trading patterns could result in substantial commercial damage, this provision was changed, reducing the minimum call up period to 4 months and the maximum to 9 months. It is now expected that SRP ships will be used to meet initial emergency requirements and then released as quickly as possible to their normal trades before foreign flag carriers can make significant inroads. In the meantime, reserve fleet vessels can be activated as necessary to provide sustained support.

Other emergency preparedness activities carried out by the Maritime Administration include the development of contingency plans for emergency mobilization of ports, merchant shipping, and the shipbuilding industry. Such planning is essential because the Maritime Administration, in its capacity as the National Shipping Authority, would be responsible for port and merchant shipping operations during mobilization and would share shipbuilding responsibility with the Navy. Planning activities in these areas are fully coordinated with other relevant Federal agencies and with the appropriate elements of NATO.

Finally, a number of Maritime Administration activities are carried out in response to growing national concerns for environmental protection and energy development, transportation and conservation. In the area of environmental protection, the agency participates in a wide variety of domestic and international programs designed to minimize the adverse environmental consequences of activities related to marine transportation. A primary concern of the Maritime Administration in this area is to maximize marine environmental protection while at the same time assuring that full advance consideration is given to the potential impact of various environmental initiatives on U.S. shipping and trade.

In the area of energy production, MarAd has become a major participant in supporting capital investment in the rapidly expanding offshore drilling industry. For fiscal year 1976, about one-third of the total value of loans guaranteed under the Title XI program was accounted for by loans for drilling ships, platforms, and drilling service vessels.[60]

In the area of energy transportation, a number of special analyses have been made or are underway to assess anticipated future requirements for various types of energy carriers, ranging from tankers to liquefied natural gas carriers to propane and butane carriers. One recent example was a study released in October 1976 assessing the adequacy of the U.S. tanker fleet to meet oil carriage requirements for the Alaska oil trade and to analyze expected requirements for the Strategic Petroleum Reserve.[61] This study, and subsequent assessments, led to steps to augment the U.S. domestic fleet by allowing temporary employment of some subsidized tankers in the Alaska trade upon repayment of subsidy. Steps also have been taken recently to authorize limited participation by some ODS tankers in the carriage of preference oil destined for the Strategic Petroleum Reserve. While engaged in such carriage, however, these tankers will not receive operating subsidy.

With respect to energy conservation, the Maritime Administration conducts a variety of research and promotional programs aimed at improving the energy efficiency of the U.S. shipping and shipbuilding industries. In conjunction with efforts in this area, close and continuous coordination is maintained with appropriate agencies of the Department of Energy.

[60] U.S., Department of Commerce, Maritime Administration, *MARAD '76: The Annual Report of the Maritime Administration for Fiscal Year 1976 and the Transition Quarter Ending September 30, 1976.* Washington, D.C., Government Printing Office, April 1977, p. 83.

[61] U.S. Department of Commerce, Maritime Administration, Office of Policy and Plans. *The U.S.-Flag Tanker Fleet and Domestic Carriage Requirements—An Assessment of Fleet Adequacy.* October 21, 1976.

Although the specific objective of initiating the construction of 300 merchant ships between 1971 and 1980 was included in the 1970 Act, it is now evident that this goal is not likely to be achieved. By mid-1977 construction-differential subsidy (CDS) had been awarded for a total of only 66 new ships, aggregating 6 million deadweight tons and valued at $3.3 billion. In addition, CDS contracts had been let for the reconstruction or conversion of 27 existing general cargo vessels to modern containerships.

It is important to note that progress toward the 300-ship goal is somewhat understated by the raw CDS construction figures alone. When the 300-ship objective was established, it was predicated on the construction of vessels generally smaller than those which have actually been contracted for to date. Despite this partial distortion, however, it is nonetheless clear that the level of new construction under the program has fallen short of the objective.

A major factor impeding progress toward the 300-ship goal has been the worldwide shipping and shipbuilding recession which began after the 1973 Arab oil embargo. The tanker industry was particularly hard hit by this recession, and in April 1976 (the peak of the recession's impact on the tanker fleet) about 50 million tons of tanker capacity was idled around the world. In addition, foreign trade generally was hampered by the precipitous rise in oil prices following the embargo. As a consequence of these events, commercial demand for new U.S. vessels all but evaporated despite the availability of expanded Federal assistance under the 1970 Act.

Of course, since 1970, additional construction beyond that supported by construction subsidies has also been initiated under the expanded Title XI mortgage guarantee program. While such mortgage guarantees have been used extensively to secure financing in conjunction with CDS-supported projects, the Title XI program also has aided in financing an additional $2 billion worth of nonsubsidized construction since 1970. Considering all U.S. merchant ship construction from mid-1972 through the end of 1976, U.S. shipyards delivered a total of 98 new merchant vessels representing more than 5.2 million deadweight tons of new U.S. capacity.

Thus, although the success of the 10-year building program has been mixed and while U.S. shipyards will clearly require additional contracts to sustain present production levels, the current shipyard orderbook in the United States is substantial. It should be emphasized, however, that because new orders have not kept pace with deliveries, this orderbook is expected to begin a serious decline by mid-1978. Over the past few years, U.S. shipyards have been partially insulated from the full impact of the world shipbuilding recession principally because of construction demands associated with large new domestic trade requirements. Among these, the most notable has been the U.S.-flag tanker requirement associated with the delivery of Alaska oil. As of June 1, 1977, the U.S. orderbook for new merchant ship construction consisted of 69 vessels, totaling more than 6.2 million deadweight tons and valued at $4.2 billion. Of these 69 ships, 46 are tankers.

In assessing progress under the Merchant Marine Act of 1970, it is interesting to compare various 1982 trade penetration projections developed by MarAd shortly after enactment of the 1970 Act [62] with the U.S. participation rates which have actually been attained thus far. Although changes in the U.S. foreign trade outlook and changes in the construction mix have rendered these early projections largely obsolete, the comparison provides a useful indication of how far U.S.-flag trade penetration results are likely to vary from those originally expected under the 300-ship program.

Overall, MarAd projected that the new program could be expected to yield U.S.-flag foreign trade penetration of between 14 percent and 17 percent in terms of tonnage by 1982. However, by 1976, U.S. foreign trade participation was only 4.9 percent by tonnage, just slightly higher than the 4.6 percent level that had been attained in 1969 before the new program.[63] While total U.S.-flag foreign trade carriage grew dramatically over this period, total U.S. trade grew at an equal pace.

The 1982 expectation for *liner* trade penetration was set at 35 percent to 50 percent in terms of tonnage and 50 percent in terms of value. In 1976, U.S.-flag vessels transported more than 30 percent of the tonnage of liner cargoes in U.S. foreign trade and these cargoes represented more than 31 percent of the total value of such cargoes. Comparable U.S. penetration figures for 1969 were 23 percent by tonnage and 27 percent by value. The favorable trend since 1969 in this area reflects a substantial upgrading and modernization of the U.S. liner fleet principally through the incorporation of intermodal technology. Today the U.S. intermodal fleet is the

[62] U.S. Department of Commerce, Maritime Administration, Office of Policy and Plans. *New Maritime Program Progress Analysis Report on the Objective: To Increase U.S.-Flag Participation in the U.S. Foreign Trade.* Unpublished Maritime Administration Report, March 1972, p. 8.

[63] The 1976 trade penetration figures presented in these paragraphs are based on preliminary Census data as reported in U.S. Department of Commerce, Maritime Administration, Office of Subsidy Administration, *U.S. Oceanborne Foreign Trade Report, December 1976, No. 3 Annual Recap.* Washington, D.C., Maritime Administration, September 1977. Prior year penetration figures are from U.S. Department of Commerce, Maritime Administration, *MARAD '76: The Annual Report of the Maritime Administration for Fiscal Year 1976 and the Transition Quarter Ending September 30, 1976.* Washington, D.C., Government Printing Office, April 1977, p. 76.

largest and most modern in the world and includes 105 containerships, 23 lighter or barge carrying vessels, and 14 roll-on/roll-off vanships. It now appears that the expected tonnage penetration range in this area may still be achieved. However, the value penetration level originally expected is not likely to be attained.

Under the 1970 program, it was originally expected that the tankers to be built would yield capacity sufficient to carry about 10 percent of the liquid bulk cargoes moving in the U.S. foreign trade. The trade forecast upon which this expectation was based, however, did not anticipate the explosive growth in U.S. dependence on foreign oil and on more distant sources of foreign oil. As a consequence, even though U.S. tanker construction has greatly exceeded original estimates, trade penetration gains have not been large.

In 1969, U.S.-flag tanker carriage represented 3.2 percent of total tanker tonnage. In 1976, this penetration was 4.2 percent. Because of the currently depressed state of the world tanker market and the unanticipated need to carry large quantities of Alaska oil to U.S. Gulf Coast markets via Panama, foreign trade penetration gains in the short term will remain difficult to achieve. Some U.S. vessels that would otherwise be expected to engage in foreign commerce if rates were stronger will be drawn to the protected domestic carriage of Alaska oil until such time as a pipeline is developed to transport the West Coast surplus to other U.S. markets. As capacity is released from the Alaska trade (after completion of one or more of the proposed West Coast pipelines), U.S. foreign trade penetration could improve substantially, depending on the level and source of total U.S. oil imports, the condition of the world tanker market, and the ability of U.S. carriers to compete for foreign trade cargoes.

As noted previously, the dry bulk segment has been the least responsive element of the U.S. fleet to the new expansion incentives provided under the 1970 Act. Only two ore/bulk/oil carriers have been built under the program, and the U.S. dry bulk trade penetration level today is lower than the 1969 level. Originally, the construction of a substantial number of dry bulk carriers was anticipated and the expected 1982 U.S. penetration level was set at 14 percent of total tonnage. It is evident that this level of penetration is not likely to be achieved, although MarAd is actively investigating new initiatives in an attempt to improve performance in this area.

During the first 5 years of the new maritime program, the construction subsidy rate objectives incorporated in the 1970 Act were met fully. All CDS contracts awarded in fiscal year 1971 were held below the 45 percent ceiling established for that year and, as the ceiling declined by 2 percentage points each year thereafter, these goals too were met through the end of fiscal year 1975, by which time the CDS ceiling had fallen to 37 percent. In part, this early success was aided by the two dollar devaluations that occurred in December 1971 and February 1973. In addition, however, improved shipbuilding productivity encouraged under the 1970 Act, also contributed significantly to this success. Since enactment of the 1970 Act, the shipbuilding industry has invested more than $1 billion in modernization and capital improvements.

Progress in reducing CDS rates ended abruptly in fiscal year 1976, however, as the recession in the world shipbuilding industry became severe. In the wake of numerous order cancellations, the competition for replacement orders became acute and foreign construction prices plummeted. As a consequence of these developments, the U.S./foreign construction cost differential widened and the CDS rate objective of 35 percent for fiscal year 1976 became unattainable.

Since authority to award *competitive bid contracts* with CDS rates up to 50 percent was still available under the 1970 Act, a contract for the construction of two vessels was awarded in fiscal year 1976 under this provision at a CDS rate just under the 50 percent ceiling. *Negotiated contracts,* however, were not authorized at the higher rates because use of that procedure had been conditioned on meeting the specific CDS objectives.

Only July 31, 1976, the declining construction subsidy rate goals were completely abandoned with enactment of a new amendment to the Merchant Marine Act, which reinstated negotiated contracting authority without regard to CDS objectives. Under this authority, which extends through June 1979, the 50 percent CDS statutory maximum rate still applies as it does in the case of competitive bidding. All of the other requirements associated with negotiated contracting must still be met, but the lower CDS ceiling requirements previously imposed have been eliminated. It should be emphasized that the construction of LNG vessels has been possible at CDS rates well below the statutory maximum. In fact, all CDS-sponsored LNG construction to date has been at rates below the goals originally set in 1970.

In looking at the total record of progress since enactment of the Merchant Marine Act of 1970, it is clear that while the pace of maritime revitalization has not been as rapid as originally hoped, and while progress has been extremely disappointing in some areas, many significant gains have been made. For example, although the number of privately owned vessels in the U.S. fleet declined from 793 in 1970

to 579 at the end of 1976, the aggregate cargo capacity of this fleet increased from 14.4 million to 15.6 million deadweight tons, In addition, average speed increased, average age declined, and the proportion of intermodal vessels expanded substantially. All of these factors have contributed to a steady increase in the aggregate delivery capacity of the fleet and to the reliability of U.S. commercial carriage.

Major Current Issues

Over the next few years several identifiable issues are likely to be of major concern in the development and execution of Federal maritime promotional policies and programs. This section considers these emerging issues.

First, a number of special demands for U.S. tanker capacity will be imposed on the U.S. merchant fleet as a consequence of Alaska oil trade requirements and preference requirements associated with establishment of the Strategic Petroleum Reserve. These demands are likely to require continuing Federal attention to assure the appropriate allocation of available tonnage to meet these requirements. A brief discussion of these and other potential sources of U.S. tanker demand is included in the paragraphs below.

As Alaska pipeline production expands beyond the 700,000 barrel-per-day level sometime early in 1978, the quantity of Alaska oil which will be surplus to West Coast needs is expected to increase significantly. To dispose of this regional surplus, a large number of tankers will be needed to transport this oil via Panama to other U.S. markets until such time as a pipeline to accommodate the surplus can be developed (probably not before 1980). Because this is a domestic movement subject to the cabotage provisions of the Jones Act, only U.S.-flag tankers will be eligible to participate in this trade.[64] Assessments by the Maritime Administration indicate that the Alaska trade requirements (including surplus disposition via Panama) will be within the aggregate capacity of the U.S. fleet after full consideration of other domestic carriage requirements. However, some augmentation of the *non-subsidized* tanker fleet will be necessary in order to meet fully the Alaska trade requirements.

As a consequence of these findings, the Maritime Administration published regulations in the *Federal Register* on June 29, 1977, specifying the terms and conditions under which certain large U.S. subsidized tankers may be authorized to temporarily engage in the carriage of oil from Alaska to the western entrance of the Panama Canal. In compliance with the requirements of the Merchant Marine Act, eligibility for such domestic carriage will be limited to 6 months in any given year and will require the repayment of a portion of any construction subsidy previously received. Tankers in the authorized size range (100,000 dwt and over) do not receive operating subsidy. So far, several tankers have been granted Alaska trade eligibility under these special provisions. In administering this program, careful consideration will be given to meeting the Alaska trade requirements while at the same time protecting the interests of non-subsidized domestic operators.

Establishment of a National Strategic Petroleum Reserve (SPR) will present U.S. tanker operators with another important trade opportunity over the next few years. Under the cargo preference provisions of the Merchant Marine Act, 50 percent of the oil imported for the SPR must be carried by U.S. tankers to the extent such vessels are available at fair and reasonable rates. Preliminary MarAd assessments of SPR fill demand indicate that full 50 percent U.S. participation may not be possible in all periods of the fill cycle because of peaks in the FEA fill schedule, rising Alaska trade requirements, and, in the near term, the nonavailability of a number of U.S. vessels still under construction.

Under the terms of their operating subsidy contracts, some 22 U.S. ODS tankers are precluded from participating in the carriage of preference cargoes. However, in order to avoid losing part of the petroleum reserve preference opportunity, the Maritime Subsidy Board has recently granted special eligibility to several ODS tankers to participate in the carriage of SPR preference oil. Owners of these vessels have in turn agreed to forego ODS during periods of such preference employment.

An additional demand for U.S. tanker tonnage would have been imposed had commercial oil cargo preference legislation been enacted. Under the provisions of the measure, which was defeated in the House of Representatives on October 19, 1977, a portion (rising to 9.5 percent by 1982) of U.S. commercial oil imports would have been reserved for carriage by U.S. flag tankers to the extent such vessels were available at fair and reasonable rates. Although this is the third time that efforts to enact some form of legislation for commercial oil cargo preference have failed, proponents are not likely to abandon the issue. References have already been made to another attempt at enactment.

A final source of added U.S. tanker demand would follow enactment of legislation to bring petroleum

[64] Because the Jones Act does not currently apply to trade between the U.S. and the Virgin Islands, it may be possible that some Alaska oil could be transported by foreign-flag vessel to be refined in the Virgin Islands and the product subsequently transported to the mainland via foreign-flag vessel. (See material to follow for further discussion of this issue and the general issue of Jones Act applicability to other elements of the Virgin Islands oil trade.)

imports from the Virgin Islands under the cabotage provisions of the Jones Act. Originally excluded from the Jones Act in order to aid the island economy by keeping prices down on essential items imported from the mainland, the Virgin Islands in recent years has become a major Caribbean refining center. Because of the Jones Act exclusion, oil products refined in the Virgin Islands may be conveyed to the U.S. East Coast in foreign flag vessels providing Virgin Islands refiners with a competitive advantage over Gulf Coast and Puerto Rican refiners who must use higher cost U.S. vessels to carry their products to market. If legislation is enacted extending Jones Act requirements to the Virgin Islands, an immediate demand for an estimated 750,000 deadweight tons of nonsubsidized U.S. tanker capacity would be imposed. Pressures to extend the Jones Act to the Virgin Islands oil trade could increase substantially if shipments of surplus Alaska oil are allowed to be made aboard foreign-flag tankers when processed through Virgin Islands refining facilities. The Treasury Department (which is responsible for administering the Jones Act) has ruled that such shipments are not subject to cabotage under current law.

It is interesting to note that an incentive, which will assume greater importance in the years ahead, for using U.S. ships in the Virgin Islands oil trade already exists under the oil import fee program. Essentially, this provision allows importers bringing oil products in from the Virgin Islands to reduce their import fee obligations if a U.S.-flag vessel is used. To date, this provision has had little effect because most of the oil now imported from the Virgin Islands is imported without fee. The amount of oil subject to fee is expected to increase rapidly in the next few years, however, making this U.S.-flag fee incentive far more important.

The effectiveness of the fee incentive in encouraging the use of U.S. ships will, of course, depend on the relationship between the U.S.-flag fee saving and the transportation saving available by using a foreign vessel. Furthermore, the applicability of the fee program to the Alaska oil processing scheme is currently unclear. Extension of the Jones Act to the Virgin Islands oil trade would presumably eliminate the fee incentive program altogether and simply require exclusive carriage by U.S. vessels.

The need to expand the U.S. dry bulk fleet can be expected to be another major area of concern for the foreseeable future. Today the United States has an annual dry bulk trade (including both imports and exports) of about 275 million tons, and it has been estimated that under wartime circumstances a minimum of 50 million tons of imported dry bulk materials would be required annually from outside North America to keep the American economy in operation. Because U.S.-flag dry bulk trade participation currently stands at less than 2 percent, many have identified this component of U.S. sealift capacity as the segment in greatest need of attention.

In response to this concern, the Maritime Administration is assessing a variety of administrative and legislative initiatives to encourage the development and maintenance of an expanded U.S. dry bulk capacity. The types of initiatives that have been considered in this area include:

- Revision of certain regulations governing the operating-differential subsidy program to assure that U.S. dry bulk vessels which are operated under ODS contract achieve full U.S./foreign cost parity.
- Provision of greater trading flexibility through an expanded allowance of foreign-to-foreign trading.
- Development of prototype and standard design vessels that would be given preference over nonstandard designs in terms of Federal aid.
- Elimination of the ship replacement obligations for bulk operators who enter operating subsidy contracts with new vessels.
- Amendment of Section 804 of the Merchant Marine Act to allow owners of subsidized U.S. dry bulk vessels also to operate bulk carriers under foreign flag providing safeguards are incorporated to prevent the diversion of subsidy to support the foreign operation.
- Liberalization of the Capital Construction Fund provisions of the Merchant Marine Act to allow American owners of foreign flag dry bulk shipping to deposit earnings from foreign operations into a tax-deferral CCF for the purpose of accumulating funds for building new dry bulk vessels in the United States.

These and related considerations pertaining to the special problems associated with expansion of the dry bulk fleet are likely to remain important issues in the future both in administering existing programs and in considering possible new legislative initiatives.

Liquefied natural gas (LNG) carriers are fast becoming a major factor in the outlook for U.S. shipping and shipbuilding. This reflects the growing importance of LNG as an energy source and the prominent position attained by the U.S. shipbuilding industry in the development and construction of LNG vessels. Currently, the world LNG fleet consists of 37 vessels with an aggregrate capacity of more than 3 million cubic meters. An additional 34 ships, totaling about 4 million cubic meters, are now under construction or on order around the world, and half of this additional capacity is on order from U.S. yards.

At the present time, eight U.S. liquefied natural gas carriers are being built with construction subsidy and Title XI mortgage guarantees to bring foreign LNG to the United States. (One additional vessel intended for the U.S. foreign trade has already been delivered.) Seven LNG ships destined for foreign-to-foreign service are also on order from U.S. yards with Title XI

financing assistance. Finally, two more vessels are on order (with no request for government aid to date) for potential use in the U.S. import trade. Orders could soon be forthcoming for as many as 16 more LNG vessels to carry U.S. gas imports.

The prospects for U.S. shipping and shipbuilding in the LNG area will depend on future policy responses to such issues as the growing public concern for the safety of LNG transport [65] and the concern over increased U.S. reliance on foreign energy sources. One important potential source of LNG carrier employment was recently eliminated by the President's decision to support the trans-Canada pipeline option for transporting Alaska natural gas to the "lower-48." Had the trans-Alaska option been adopted, it is estimated that from 8 to 11 LNG carriers would have been used in the transportation operation from the liquefaction plant in Southern Alaska to regasification facilities on the West Coast.

The issue of U.S. ownership of foreign-flag shipping and the defense utility of such shipping has long been debated. It is likely that this issue will continue to be argued, particularly in conjunction with discussions of U.S. policies which tend to aid the owners of foreign tonnage.

As indicated previously, the lapse in authority under the War Risk Insurance Program from September 1975 through October 1976 can be traced to Congressional concern over the appropriateness of providing war risk insurance coverage to foreign-flag carriers. While foreign coverage authority was finally extended until September 1979, foreign-flag eligibility standards were tightened to require that specific consideration be given to ". . . the characteristics, the employment, and the general management . . ." of any foreign-flag vessel seeking coverage in order to determine if extension of coverage would be ". . . in the interest of the national defense or the national economy . . ." In addition, all insured vessels, both U.S. and foreign, were made subject to strict location reporting requirements. While these changes did not alter the fundamental nature of the war risk insurance authority, they did offer clear evidence that it is the intent of Congress that the War Risk Insurance Program be used to provide access to needed shipping resources in a national emergency—not simply to protect U.S.-owned foreign shipping assets.

Another form of controversial foreign-flag assistance is provided through the current tax treatment of certain income earned by U.S. owners of foreign-flag shipping. Under the terms of Subpart F of the Internal Revenue Code, certain types of income of American-controlled foreign corporations must be included as income to the U.S. shareholder in the year it is earned by the foreign company even if it is not distributed in that year to the U.S. shareholder. One such category of income subject to current taxation is foreign base company service income which consists of income derived from the performance of services by a U.S.-controlled foreign corporation for a related person or corporation outside the country in which the U.S.-controlled foreign corporation is organized. In the Internal Revenue Code, however, there is an express statutory exclusion of shipping income from these foreign base company income provisions. It is due to this exclusion that the income of a U.S.-controlled foreign shipping corporation is generally not subject to U.S. taxation in the year in which it is earned, even though the ships may have been performing services for the U.S. parent corporation throughout the year.

In 1975, with enactment of the Tax Reduction Act of 1975, the value of the foreign subsidiary shipping income exclusion under Subpart F was somewhat diminished. Effective January 1, 1976, the new law eliminated the income exclusion on foreign shipping income that is not reinvested in shipping operations. As a consequence of this change, the House of Representatives Committee on Ways and Means estimated that additional tax revenues of $35 million would be collected each year. Income reinvested in foreign shipping, however, remains eligible for tax deferral.

Since the Subpart F shipping income exclusion still provides a significant tax benefit to foreign-flag shipping (Treasury estimates place the tax revenue loss at between $90 million and $140 million per year), it has been argued that it encourages foreign registry and is therefore contrary to U.S. maritime policy. This issue will, no doubt, continue to be raised in conjunction with future deliberations relating to both U.S. maritime policy and U.S. tax policy.

Repeated demonstrations of the utility of the National Defense Reserve Fleet (NDRF) in times of national emergency and the continuing decline of this national shipping asset have led to growing demands for NDRF renewal. Under existing law, subsidized operators have had the option, in conjunction with their vessel replacement obligations, to sell older mer-

[65] U.S. Congress, Office of Technology Assessment. *Transportation of Liquefied Natural Gas.* Washington, D.C., Government Printing Office, September 1977. This source provides an excellent recent summary of U.S. LNG policies and projects and is particularly useful in delineating the major safety issues associated with LNG transportation.

An issue closely related to considerations of LNG vessel safety which may assume importance in the near future relates to the question of whether Government indemnification to a shipbuilder may be made available under Public Law 85-804 (or if such indemnification authority should be provided) to cover LNG vessel product liability claims. Public Law 85-804 grants the President the authority to authorize any department or agency of the Government exercising functions in connection with the national defense to execute or amend contracts whenever he deems that such action would facilitate the national defense. Although shipyard indemnification for LNG vessels constructed with CDS has not yet been decided, recent developments in product liability law coupled with limited availability of adequate commercial insurance may necessitate consideration of indemnification in the near future.

chant ships to the Federal Government at their government-appraised value. Until recently, however, this option was generally not exercised because prices were better on the open market. As a consequence, many opportunities to improve NDRF capacity were missed. In the past few months, this situation has improved dramatically and, since the beginning of January 1977, five C-3 cargo ships have been acquired under this program and placed in the NDRF. In addition, three C-4 cargo ships have been contracted for and will be added to the reserve fleet in 1979 and 1980 when their replacements are delivered. Furthermore, it is now expected that eight more vessels may soon be contracted for under this authority. Because the quality of vessels acquired to date under this program has been high, all have been identified for inclusion in the Ready Reserve Fleet program under which these vessels will be maintained in an advanced state of readiness.

Despite these improvements under the subsidized vessel replacement program, it is likely that other initiatives will be required if a substantial NDRF renewal is to be attained. One recently-enacted program will allow the Secretary of Commerce to exchange NDRF scrap candidates for Mariner class vessels and other suitable commercial ships destined to be scrapped by their owners. The basic purpose of such a program will be to exchange equally valued scrap ships in anticipation that the ships traded in will have greater emergency defense utility than the vessels traded out. Authority for a similar exchange program covering only Mariner vessels expired in January 1977 without having been used. There are two major problems with this approach to NDRF renewal. First, there are only a limited number of ships remaining in the NDRF that could be traded out under this program and, second, the quality of vessels traded in is likely to be quite low if their only remaining commercial value is as scrap. Hence, this exchange program cannot be viewed as a major fleet renewal effort, although it may yield some marginal improvement.

In the past, various proposals for NDRF revitalization have been advanced which would allow the Government to continually purchase, from private interests, a small amount of shipping which has high defense utility, but which has reached the end of its commercial life. It is likely that as the NDRF continues to age, this type of program will again receive renewed attention. Without a major renewal initiative, at some point in the not too distant future, the NDRF decision is likely to be made by default.

Another very important issue that is likely to assume growing importance in the near future is the U.S. shipbuilding outlook in light of the lack of new orders in recent months. Unless new orders are received soon, the U.S. shipbuilding industry faces a precipitous decline in business and an associated decline in employment. The loss of jobs in shipbuilding and allied industries and in other sectors of the economy could be substantial and would be concentrated in areas which already face serious employment difficulties. According to Department of Labor data, 16 of the Nation's 20 major shipyards are in areas which now have substantial unemployment.

A major loss of jobs in the shipbuilding industry would also seriously affect the employment levels of minorities and women in shipbuilding. A large portion of the recent gains in this area would be lost because of the generally lower seniority of minorities and women in a "last-in, first-out" labor environment.

Productivity improvements resulting from the $1.3 billion of private capital invested in commerical shipyards since 1970 also would be jeopardized by a declining orderbook. A stable or expanding workload is needed to maintain productivity, efficient use of facilities, and the economic capability to compete for new orders.

A final area which will assume considerable importance over the next few years is the operating subsidy program, as a number of long-term operating differential subsidy contracts for liner operations come up for renewal. As the existing 20-year contracts expire and operators apply for renewal, the Government will have an opportunity to reevaluate and revise a substantial portion of the current ODS program.

In processing applications for ODS contract renewal, particular attention will be directed to controlling rising costs while continuing to support the U.S. ship operating industry in compliance with national maritime policy objectives. Three categories of subsidizable expense have been identified which probably could be reduced or eliminated without undue hardship to the U.S. operating industry. The maintenance and repair category, which in 1975 accounted for about 6 percent of total ODS accruals, has already been eliminated from several ODS contracts and is likely to receive careful consideration in future contract assessments. Subsidy for hull and machinery insurance premiums (slightly less than 1 percent of 1975 ODS accruals) also has been eliminated from some contracts, and subsidy on premiums for protection and indemnity insurance (about 2 percent of 1975 accruals) is considered a likely candidate for ODS reduction in the future.

The only other category of subsidizable expense for liner cargo operations is the wage category,[66] which, in recent years, has alone accounted for 90 percent or more of total ODS accruals. Control of this item of expense since 1970 is considered to

[66] It should be noted that ODS is also available in support of officer and crew subsistence, but only on passenger ships. With the decline in passenger ship operations, this subsidy item is being rapidly phased out.

have been fairly rigorous, because of the use of the wage subsidy index system (which ties subsidizable U.S. wage expenses to a general U.S. wage index) and because of successful efforts to reduce total manning levels on U.S.-subsidized vessels.

In addition to the cost control expected to be achieved through the elimination of certain subsidizable expenses a thorough reassessment of the entire ODS program has been initiated recently by the Maritime Administration in an effort to identify changes which might enhance the efficiency of the ODS fleet and thereby reduce future subsidy dependence. Essentially, this study will address the possible productivity benefits to be derived from allowing subsidy recipients greater operating flexibility. A principal focus of this study will be an examination of the appropriateness of the essential trade route concept in light of the impediments it imposes on operating flexibility.

These then are some of the major specific issues which are likely to be of prominent concern over the next few years with regard to the promotion of U.S. shipping and shipbuilding. In addition, of course, many of the infrastructure and regulatory issues discussed in the previous sections will also include important promotional considerations. As a consequence, it can be expected that careful attention will also be directed to many of these issues with respect to their potential effect on the future of the U.S. merchant marine.

Chapter VI: The Marine Environment

The Ocean and the Marine Environment

The marine environment includes the coastal zone, estuaries, shelf waters, and open ocean. These oceanic regions are environmentally related and impacts in one region can have profound effects on the waters of another. The coastal environment and land-based activities directly affect the health and productivity of coastal waters.

Offshore waters are common property resources. Unlike land, they belong to no individual. As such, the ocean has suffered the "Tragedy of the Commons." [1] Without the vested interests of property owners, a resource can be depleted or the environment can be degraded for present benefits without regard for the future. Protection of the environment and preservation of natural resources held in common by the public are secondary to immediate profit since there is no assurance that other exploiters will not reap the benefits. International cooperation and government regulation and control can be effective tools for protection of common property resources. It is this feature that sets the ocean apart from land-based, privately owned property.

Environmental Pressures

Pollution problems did not originate with the 20th century, but the accelerated discovery of new substances and consumption of energy in this century have added to both the abundance and kinds of wastes that must be disposed. With the increasing need to dispose wastes from human activities has come the realization

- that not only the amount, but the nature and behavior (fate and effects) of pollutants are cause for concern;
- that the ocean does not have an infinite capacity for waste assimilation; and
- that the problem of pollutants and their derivatives, which are brought about by technological and economic development and demographic change, is likely to worsen rather than improve.

The absence of alternative methods for land-based disposal of wastes from human activities has forced man to turn to the ocean with increasing frequency. With the discovery and expanded use of derivatives of organic compounds, such as halogenated hydrocarbons and synthetic organic chemicals resistant to degradation, modern society has the potential to inflict more lasting effects on the marine environment. The use of toxic materials in industrial processes, and their presence in consumer products, continues to expand. Many of industries' newly developed synthetic and organic chemicals, or their byproducts, will reach the sea. A 1975 report of the National Academy of Sciences—*Assessing Potential Ocean Pollutants*—identified transuranic elements and hexachlorobenzene as potential problems, but did not consider substances now being developed. It is uncertain what the nature of newer compounds will be, but, based on past experience, it seems likely they will be more complex and will involve organic species not previously used in commercial products.

The expanding use of nuclear power for the production of energy and the use of radioactive materials in industrial processing pose other problems. The disposal of nuclear wastes, as use of nuclear power expands, is a growing problem. Recent proposals include disposal of encapsulated nuclear wastes in the sediments of the deep seabed.

Oceanborne transport of petroleum in increasing quantities holds greater potential for acute pollution from discharges of oily ballast waters and tank washings and from oil spills caused by vessel accidents. Added to these are the chronic cumulative effects of smaller operational and accidental discharges to the marine environment. In 1960, the United States imported about 1.7 million barrels of oil each day. The amount doubled by 1970, and doubled again by 1976 to 7.3 million barrels of oil per day. Projections for 1985 indicate the United States will receive an average of 12 million barrels of foreign oil per day. The marine transportation industry is shifting to fewer, but larger, carriers. Recent estimates indicate that ship casualties account for about 5 percent of the oceans' petroleum hydrocarbons. This could

[1] Garrett Hardin. "The Tragedy of the Commons." *Science* 162: 1243–1248, 1968.

increase as greater quantities of petroleum are transported; however, with fewer (although larger) ships, the probability of an accident decreases and the net results are uncertain. If there were a supertanker casualty, the potential spill could be of major proportions and affect both living and nonliving marine resources, as well as the recreational use of coastal areas.

All pollutants are not chemical or particulate in nature. Energy conversion is exothermic, and large amounts of heat energy are transferred to the aquatic environment in the production of electrical energy and in other industrial activities. Coastal regions attract industries that require large quantities of cooling water. If discharged into confined estuaries, the waste heat can be considered a pollutant to the extent that it adversely affects the productivity of the marine environment. In some instances, thermal enrichment can prove beneficial by increasing marine productivity.

The rate of ocean pollution has increased with population density and societal affluence, which were not accompanied by recognition of pollution as a priority issue. The increasing production of energy and conversion of materials to consumer goods are the basic causes of pollution. Thus, the industrially developed nations of the world, generally in the Northern Hemisphere, are the prime sources of environmental pollution. In the past, man turned to the oceans for waste disposal because costs of land and transportation were rising and it was more economical to dump wastes in the ocean, particularly the wastes of coastal cities and industrial centers; because dumping in the ocean involved fewer political conflicts; and because people believed the ocean had an infinite capacity to absorb such wastes. With our better understanding of the ocean's physical, chemical, and biological processes—its interactions with the atmosphere and adjoining lands, and its mechanisms of mixing, transport, and exchange—we now know that the ocean cannot accept unlimited pollutants without affecting our well-being (fig. 6–1).

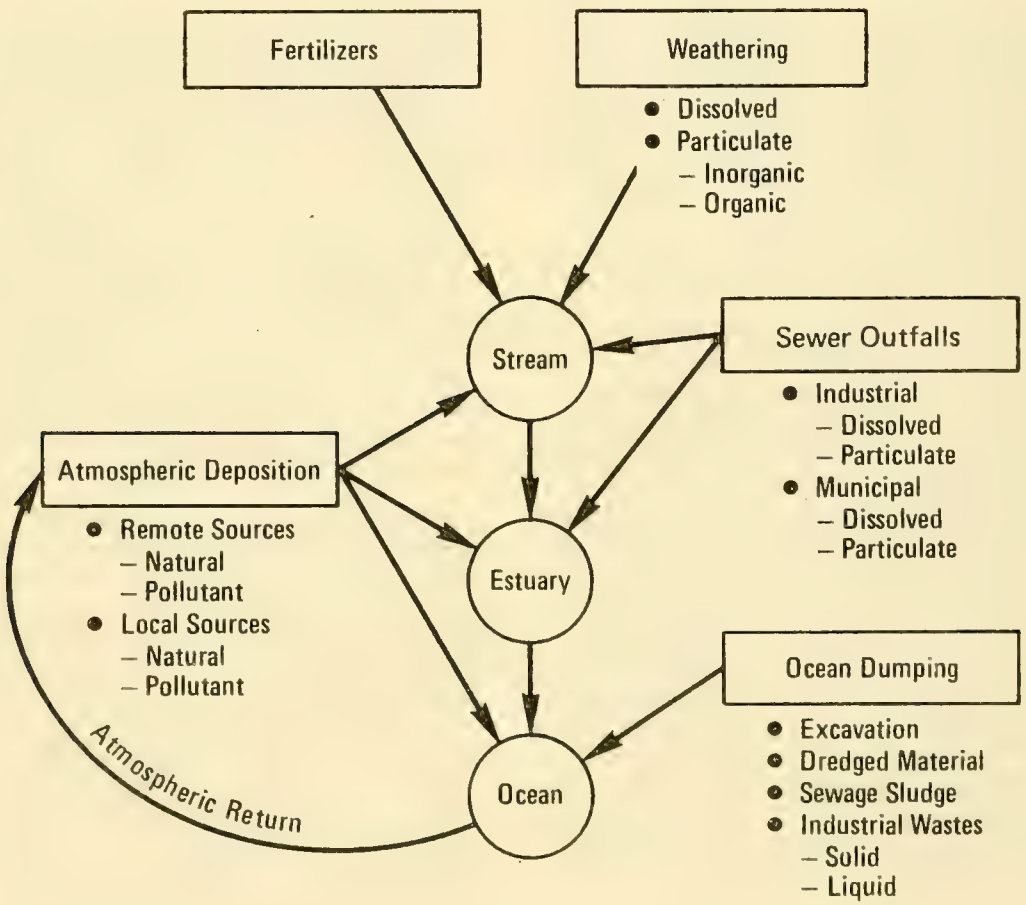


Figure 6–1.—Chemical enrichment of the ocean

The processes of biological production and the physical/chemical factors are so intimately coupled that perturbations in either the biotic or abiotic subsystems can significantly affect the ocean environment and living ocean resources. One of the most dramatic examples of the linkages among the various components that make up the ocean environment is the sporadic occurrence of the El Niño phenomenon. When currents of warm water of lower salinity move from the North Pacific along the west coast to South America displacing the normally cold, rich, upwelled water from the ocean depths, the productivity of the ocean system is altered. In 1972, the El Niño phenomenon, in combination with overfishing, had devastating effects on the anchoveta stock and reduced the catch significantly. The economic impacts of the failure of this fishery were felt throughout the world. Fish meal production, a major source of chicken and livestock feed, was curtailed, and meat prices increased significantly.[2, 3] Secondary impacts were further felt in the soybean market as the demand for feed protein was transferred to the agricultural sector.

Marine organisms can accumulate certain chemicals in amounts far exceeding their concentrations in seawater. Organisms may assimilate a chemical directly from seawater or by way of the food chain. Levels of bioaccumulation of certain chemicals tend to magnify in organisms at the higher trophic levels in the food web. Since we are at the highest trophic level, the potential exists for direct adverse impacts to human health in addition to the indirect effects we experience as a result of the continuous alteration of the ocean.

Bioaccumulation, however, differs for each chemical and each organism and can vary within a species from one habitat to another. The loss of one link in the food chain resulting from pollution toxicity can cause the collapse of an entire stock of fish that depends on a lost species as a source of food.

Although environmental research has been extensive during the past decade, relatively little is known about the marine processes and functions of the ocean as an integral system. The marine ecosystem, however, is resilient. It can tolerate chronic levels of pollution for extended periods of time before cumulative harm results. Unfortunately, this resiliency permits chronic pollution to continue for extended periods of time without detection, and it may be decades before the environmental impact becomes apparent. Significant damage may have already occurred, and effective future control of the pollutant might be extremely difficult or cause serious economic dislocations. On the other hand, acute doses of toxic material can interfere with life processes sufficiently to cause a catastrophic impact on the system as a whole.

One of the underlying problems of dealing effectively with ocean protection is the lack of understanding of the natural environmental processes against which the effect of civilization must be measured. If the ocean is to be managed for "use in perpetuity," more fundamental knowledge must be developed concerning the natural processes, currents, fluxes, transport phenomena, exchange rates, assimilation rates, species tolerance, and population behavior and dynamics.

Similarly, the physical and chemical behavior and toxicity of the potential pollutants themselves must be evaluated. Finally, monitoring systems are required to assess on a time-series basis the condition of the marine system and the levels of pollution and compare them with baseline information.[4]

Warnings of pending disaster have been made by Cousteau, Heyerdahl, Piccard, and many other popular lecturers.[5, 6] Local accounts of environmental damage have added to the concern over the health of the ocean. In some instances the concerns have arisen because of the effect of long-term environmental insults, as in the New York Bight.[7, 8] In other cases, local concern is voiced over one-time, sometimes spectacular, pollution events such as the breakup of the *Amoco Cadiz*.

The limits to our use of the ocean may well be imposed by our ability to maintain the sea as a functioning system. The principles of "multiple use" and "sustained yield," which have become the basic tenets of natural resource management of terrestrial ecosystems, must also be adopted as the guiding principles for management of marine ecosystems.

Management of the ocean is predicated on three fundamental requirements: (1) adequate knowledge of the natural properties; (2) an understanding of the

[2] P. Hughes, "El Niño—Science Seeks to Fathom a Strange Climatic Problem." *NOAA Magazine* January 1975.

[3] J. Kolhonen. "Impact of El Niño on World Fish Meal Trade," unpublished manuscript. NOAA National Marine Fisheries Service, Economic and Marketing Division, Washington, D.C., 1974.

[4] National Academy of Sciences. *Assessing Potential Ocean Pollutants.* A report by the Study Panel on Assessing Potential Ocean Pollutants to the Ocean Affairs Board, Commission on Natural Resources, National Research Council.

[5] Jacques Cousteau. "The Perils and Potentials of a Watery Planet," in *Oceans: Our Continuing Frontier.* H. Menard and J. Scheiber (eds.). San Diego, Calif., Publisher's Inc., 1976.

[6] Thor Heyerdahl. "How to Kill an Ocean," in *Oceans: Our Continuing Frontier.* H. Menard and J. Scheiber (eds.). San Diego, Calif., Publisher's Inc., 1976.

[7] U.S. Department of Commerce, NOAA. *Marine Environmental Protection—1976.* Washington, D.C., Government Printing Office, 1977.

[8] Pollution Wrecking Inshore Fishery, *New York Times,* September 8, 1977.

behavior, fate, and effects of potential pollutants; and (3) a system of control and regulation of the uses made of the sea and the cumulative adverse impacts that may result from such uses. The first two requirements are within the domain of the basic and applied sciences. The third is the purview of the Federal, State, and local governments within the United States, and of the international community beyond national sovereignty.

Although regulation and control of activities that can harm the ocean environment is a function of public law, regulatory programs depend on science to detect and measure pollutants and their harmful effects, to determine levels of concentration, and to establish acceptable levels of release. Important parameters that must be known about a pollutant to implement an effective regulatory system include: [9]

- rates of release into the environment,
- lifetimes in the environment (or residence times in contact with biological systems),
- concentration factors for various parts of the system (e.g., surface fills or estuaries) or in organisms (bioaccumulation), and
- levels of toxicity.

Therefore, a balance must be maintained between substantive knowledge and legal process in order to achieve optimal use of the resources, maintain economic growth, and protect the ocean environment.

The world ocean has two major zones: the coastal ocean and the open ocean. The latter comprises the bulk of oceanic space found beyond the continental slopes. With few exceptions, such as some productive equatorial waters and recently discovered areas of high productivity near the Galapagos Islands, the open-ocean areas are characterized by much lower productivity. Based on present knowledge, there is little expectation that major developments and extensive use will be made of the vast portion of the open ocean. Deep-seabed mining, for instance, would occupy but a small proportion of open-ocean space when fully developed.

The coastal ocean, on the other hand, constitutes only 10 percent of the total oceanic area and includes estuaries, lagoons, inshore waters, many marginal seas, and waters over the continental shelves and slopes. These waters are highly productive and represent the areas of greatest biological activity. Primary production of organic matter in the coastal ocean forms the basis for food chains supporting fish, birds, and marine mammals.

Within the coastal ocean are isolated areas of exceptionally productive waters—areas of upwelling—where a combination of strong offshore winds and prevailing boundary currents bring nutrient-rich deep water to the surface and move the warm coastal waters seaward. Here, the primary productivity is exceptionally high and leads to large fish stocks. The region between the littoral zone—the area just off the coastline—and the beginning of the open ocean over the continetal slope supports the most productive fisheries.

The coastal ocean is affected directly by rivers, terrestrial runoff and drainage, and by domestic and industrial wastes. The coastal region contains most of the Nation's major metropolitan areas and generally continues to increase in population and expand in industrial activity (see Chapter IV). These trends indicate a potential for increased impacts on the environment of the coastal ocean. In addition, development of oil and gas, mining of sand and gravel and other mineral commodities on the continental shelf, installation of shoreside and offshore power generating stations, siting of other water-oriented industrial activities, an increase in tanker traffic, and the expansion of oceanborne trade overall will continue to affect the environment in the coastal region unless carefully controlled.

The marine environment of the coastal ocean is of particular concern because: (1) it receives the greatest infusion of pollutants from the coastal and inland regions, (2) it is economically the most important oceanic region for the United States, and (3) to a large extent, the Federal Government and the States exert control over the activities and uses of the territorial seas. While pollution transport across international borders with Canada and Mexico and from more distant countries may occur, it is largely domestic activities that affect the coastal waters.

The Oceans and Climate

Within the world community, as well as within the United States, there is a growing awareness that our economic and social well-being are profoundly influenced by climatic variations. To some degree, energy requirements, food production, freshwater supplies, transportation, and health are all climate-sensitive, and major climate changes would affect the biological environment and the economy.[10,11] Concerns regarding climate do not center around the extremely long-term shifts such as the coming of an "ice age," but rather focus on persistent changes in

[9] National Academy of Sciences, op. cit. note 4, p. 4.

[10] National Academy of Sciences—National Research Council, U.S. Committee for the Global Atmospheric Research Program. *Understanding Climate Change—A Program for Action,* Washington D.C., 1975, p. 1.

[11] Federal Coordinating Council for Science, Engineering, and Technology, Committee on Atmosphere and Oceans. *A United States Climate Program Plan.* Washington, D.C., Government Printing Office, 1977.

present-day temperatures and rainfall patterns and the resulting impacts on food production.

The oceans exert a powerful influence on the Earth's climate, the productivity of the seas, and the changes that occur there, both naturally and as a result of our activities. Oceanic waters are vital to the Earth's climate systems. They absorb, store, and redistribute most of the solar radiation absorbed by the Earth's surface. This heat capacity regulates cyclical global climate shifts over time.

With the significant and sometimes catastrophic effect of climate on human living conditions, the need for anticipating or predicting climatic changes becomes more critical. This capability requires a better understanding of the natural interactions among the oceans, atmosphere, and climate and of the effects on climate of both oceanic and atmospheric pollution.

Development of a predictive capability requires time-series data on heat storage and stability of the oceans; exchange between the atmosphere and oceans; oceanic heating patterns and temporary and long-term anomalies, mixing depth, rate and space variations; poleward air movement and release of heat; wind stress and surface roughness; and circulating patterns. How pollution affects these factors that determine the climatic patterns is little understood.

There has been concern recently about the possible effects of the increasing level of atmospheric carbon dioxide and the corresponding capacity of the ocean to absorb greater amounts in its role as a carbon dioxide sink. Although we now understand the fundamentals of heat islands, albedo, and greenhouse effects, we have barely touched the surface of understanding the climatic effects of our own activities.

Today, atmospheric and climatic information is obtained from only 22 percent of the Earth's surface and only 2 percent of this is gathered over the 71 percent of the Earth's surface covered by the ocean.[12] No single nation has the resources or capability to collect all the necessary information. The problem belongs to *all* nations and therefore the solution will hinge on organizing cooperative efforts at both national and international levels.

Ocean Pollution Research and Monitoring

At least 8 departments, 9 independent agencies, and 37 agencies or subagencies administer Federal ocean research programs. These activities are carried on without coordinated national objectives. Each agency pursues its own objectives and interests based upon individual legislative mandates. There is some coordination and knowledge among agencies regarding other agency programs; however, in large part this depends on the individuals managing the various programs. Indeed, in some instances, even within a single agency one office is often unaware, in a meaningful sense, of another's efforts. Information gaps, duplicative efforts, and low-level accountability seem to characterize the Federal effort in ocean pollution research and monitoring.

Environmental "research" is distinguished from environmental "monitoring." The gray area between the two, however, is broad indeed. The objective of monitoring is to trace, gage, measure, or observe phenomena over time. The detail and kind of information sought determines the monitoring techniques and design to be used, e.g., remote sensing to track oils spills or sophisticated bioassays to trace a heavy metal through the food web. Research, on the other hand, is based on experimentation and investigation and is generally intended to gain knowledge about a process, form, fate, or effect of an agent in the environment.

Information from carefully designed and well-executed monitoring programs can provide a basis for managing those materials that are capable of adversely affecting the marine environment. Monitoring is necessary for an effective regulatory program.[13] "Baseline studies" are a special form of monitoring that is conducted prior to an anticipated project to provide information on the natural, "unperturbed" environment. Baseline information provides a means to measure and compare the resulting impacts through a continuous monitoring program.

Monitoring by the Federal agencies is generally done on a specific site for a specific purpose, yet time-series data on processes and pathways can be used as an indicator of potential problems that may appear in other sites. A national air and water monitoring system has been established as a result of the air and water pollution control legislation that has developed since the 1960s. A comparable system does not yet exist in the case of the marine environment. Large-scale monitoring is extremely costly, and there are practical limitations on the extent to which the ocean can be effectively monitored. Therefore, it is imperative that the Federal agencies with monitoring programs coordinate their activities and share facilities and information.

The international community is slowly recognizing the need for a global program of monitoring selected

[12] Ibid.

[13] E. D. Goldberg. *The Health of the Oceans.* New York: UNESCO Press, 1976, p. 172.

pollutants in the open ocean.[14,15] Further concern is being shown for the chronic and slowly rising levels of contaminants in the open ocean and the potential irreversible damage to the marine environment if the worldwide trend continues. An effective global monitoring program will depend upon coordinated national efforts, standardization of procedures, and free information and data exchange. This goal has not yet been achieved in the U.S. environmental program.

International Activities

During the past two decades, the level of attention directed toward problems of international marine pollution has risen sharply. In June 1969, eight North Sea countries signed the Bonn Agreement of 1969, which required member states to promptly inform other member states when they became "aware of a casualty or the presence of oil slicks in the North Sea area likely to pose a serious threat to the coast or related interests of any other Contracting Party." In June 1970, Canada enacted the Arctic Waters Pollution Prevention Act, which established controls over the depositing of wastes into the zone of arctic waters that extend 100 nautical miles north of Canada's shore. The Canadians have not claimed sovereignty over this area, but only the right to regulate pollution.[16] In October 1971, 11 governments established a regional convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, known as the Oslo Convention of 1971. It pledges the contracting states "to take all possible steps to prevent pollution of the sea by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea." [17]

In May 1972, the United States and USSR signed a bilateral agreement that established a Soviet-American Joint Committee on Cooperation in the Field of Environmental Protection.[18] In a related move, the United States and USSR joined 30 other nations in a worldwide program related to studies of ocean pollution that have been conducted during the 1970s under the auspices of the International Decade of Ocean Exploration (IDOE).[19]

The following organizations within the United Nations system have responsibilities related to various aspects of marine pollution:

Engineering Committee on Oceanic Resources (ECOR),
Food and Agriculture Organization (FAO),
Inter-Governmental Maritime Consultative Organization (IMCO) and its Marine Environmental Protection Committee (MEPC),
Intergovernmental Oceanographic Commission (IOC),
International Atomic Energy Agency (IAEA),
International Bank for Reconstruction and Development,
International Labor Organization (ILO),
Organization for Economic Cooperation and Development (OECD),
UN Development Program (UNDP),
UN Educational, Scientific and Cultural Organization (UNESCO),
UN Environmental Program (UNEP),
UN General Assembly and the Economic and Social Council,
UN Institute for Training and Research (UNITAR),
UN Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP),
UN Scientific Committee on the Effects of Atomic Radiation,
World Health Organization (WHO), and
World Meteorological Organization (WMO)

Five regional and international agreements have been concluded that relate to marine pollution by radioactive materials. Two now in force prohibit the dumping of high-level radioactive waste at sea and establish guidelines for the disposal of other types of radioactive material. They name the International Atomic Energy Agency (IAEA) as the agency responsible for defining high-level waste and developing recommendations for the at-sea disposal of other radioactive material. The IAEA's recommendations are followed by the OECD's Nuclear Energy Agency, which supervises the only active at-sea disposal program for radioactive wastes.

The International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended, is the only convention now in force that is directly related to the prevention of marine pollution from shipping. Amendments to the Convention, adopted in 1969, entered into force on January 20, 1978.

[14] U.S. Department of Commerce, National Bureau of Standards. *Marine Pollution Monitoring (Petroleum)*. Proceedings of Symposium Sponsored by IOC-UNESCO, WMO, and the Department of Commerce, NBS Publ. 409. Washington, D.C., Government Printing Office, 1974.

[15] Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). Reports and Studies No. 1. Report of the Seventh Session. London, 1975.

[16] U.S. Congress, Senate, Committee on Commerce. *Effects of Activities on the Marine Environment*. 94th Cong. 2d sess. Washington, D.C., Government Printing Office, 1975, p. 31.

[17] Ibid., p. 32.

[18] Ibid., p. 33.

[19] Ibid., p. 35.

They establish certain conditions for the discharge of oil and oily mixtures. They also require that provision be made in ports for reception facilities for residues and oily wastes from ships and that an oil record book be kept during any transfer of oil or oil-mixture. Competent authorities of a contracting state are authorized to board a vessel for the purpose of inspecting the oil record book, but under the convention, enforcement remains with the flag state.

The *Torrey Canyon* disaster prompted two 1969 Brussels conventions dealing entirely with oil pollution from ships. First, the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (known as the Intervention Convention of 1969) was entered into force May 6, 1975. This convention allows signatory states to resort to self-help in emergencies to protect their own interests from oil pollution damage. This is the first international convention to apply the principle of self-help on the high seas for the purpose of protecting the marine environment. The second Brussels convention dealt with civil liability. The International Convention on Civil Liability for Ocean Pollution Damage (known as the Liability Convention of 1969, entered into force on June 19, 1975) establishes rules and procedures for determining liability and providing compensation for damage caused by oil pollution from ships. This convention is primarily remedial rather than preventive, applying only to oil pollution after it causes damage to a limited area of the ocean.[20]

The Convention on Marine Pollution by Dumping of Wastes and Other Matters of 1972 (entered into force on August 30, 1975) has responsibility for administration centered in the Inter-Governmental Maritime Consultative Organization. The convention is aimed at achieving uniformity in regulations controlling the disposal of waste at sea among the signatory nations. The regulation of ocean dumping within the terms of the convention applies to about 10 percent of the pollutants entering the ocean. As small as this fraction is, it is a positive step toward the goal of protecting the global marine resource.[21]

The International Convention for the Prevention of Pollution from Ships of 1973 was adopted in November 1973, and reduced further the maximum permissible quantity of oil that may be discharged by new oil tankers. The 1973 Convention (1973 MARPOV) will supercede the 1954 International Convention for the Prevention of Pollution of the Sea by Oil, as amended, 1 year after ratification by 15 countries representing half of the world's merchant shipping. It contains provisions aimed at eliminating the intentional pollution of the marine environment by harmful substances and minimizing the accidental discharge of such substances. This Convention will require that ships be designed and equipped for pollution-free operations and that adequate reception facilities be provided in ports for ship-generated wastes. The flag state is required to prosecute all violations of its vessels wherever they occur. In addition, the port state is authorized to perform inspections of any vessel entering its port to ascertain that the condition of the ship corresponds with the particulars of the international oil pollution prevention certificate.

Perhaps the most dramatic example of international cooperation on behalf of marine environmental protection is the successful conclusion of the International Conference on Tanker Safety and Pollution Prevention (1978 TSPP) held in London in February 1978. Precipitated by the Presidential Initiative of March 17, 1977, the international community, under the aegis of IMCO, has agreed to an International Plenipotentiary Conference for the purpose of developing acceptable international standards in response to the U.S. initiatives. This conference successfully adopted a composite package of vessel design and equipment requirements in the form of Protocols to the 1973 Marine Pollution Convention and to the 1974 Safety of Life at Sea Convention. Their positions and the results of the Conference will have worldwide impact.

In addition to the international conventions and agreements that are now in force, the Third United Nations Conference on the Law of the Sea (UNCLOS), which has been underway since 1973, is seeking to arrive at a consensus on treaty provisions to protect the marine environment. The Informal Composite Negotiating Text of 1977 contains the following provisions: [22]

- establishes the unqualified general rule that "States have the obligation to protect and preserve the marine environment;"
- declares a positive legal duty not to cause damage by pollution to other states and their environment;
- establishes a new duty to give notice of imminent danger by pollution to other states and organizations and requires that states maintain surveillance over activities they engage in or permit;
- creates a duty to monitor the marine environment generally for pollution, and establishes an environmental assessment procedure patterned after the environmental impact statement procedures of the United States;
- recognizes land-based sources of pollution as being significant sources of marine pollution and adds them to the international agenda;
- establishes an "International Seabed Authority" to administer seabed mining under the treaty and

[20] Ibid., p. 39.
[21] Ibid., p. 41.
[22] U.S. Department of State, Office of Law of the Sea Negotiations. Third United Nations Conference on the Law of the Sea, Informal Composite Negotiating Text. Washington, D.C., July 1977, Part XII.

to develop environmental standards to govern the operations, and would thus avoid the possibility of "flags of convenience";

- establishes, in effect, a new legal rule that technical international rules and standards on protecting the marine environment will become binding on all states once they are generally accepted;
- establishes the principle that port states may prosecute foreign flag ships for discharges in violation of applicable international standards, regardless of where the discharge occurred;
- expands the coastal state powers to enforce antipollution laws within the 200-mile zone consistent with International Conventions; and
- provides legal protection of arrested vessels by requiring prompt release of vessels, reasonable bond, avoidance of danger to the vessel, nondiscrimination, a "statute of limitations on prosecutions," avoidance of multiple prosecutions for the same offense in different jurisdictions, "recognized rights of the accused," monetary penalties only, notice to the flag state and "any other state concerned" of measures being taken, and liability of the state for enforcement measures which "were unlawful or exceeded those reasonably required in the light of available information."

In an attempt to address the significant global environmental problems the United Nations held a Conference on the Human Environment in June 1972 in Stockholm. A product of the Stockholm Conference was the "Declaration on the Human Environment," which included recommendations, some of which address specifically the problems of marine pollution. These included: (1) that governments "accept and implement controls on marine pollution"; (2) that governments support marine research, particularly the Global Investigation of Pollution in the Marine Environment (GIMPE) and the Integrated Global Ocean Station System (IGOSS); (3) that the United Nations-sponsored Joint Group of Experts on the Scientific Aspects of Marine Pollution "evaluate the toxicity of potential marine pollutants and their sources and pathways in the marine environment"; and (4) that the governments support the 1973 Law of the Sea and the IMCO Marine Pollution Conferences. Among the achievements of the Stockholm conference was the creation of the UN Environmental Program (UNEP), which was established to initiate and coordinate environmental projects undertaken by the UN agencies, drawing where necessary on the "Environment Fund" (which is supported by voluntary contributions from governments) to help finance international environmental activities.[23] A major component of the UNEP program focuses on the marine environment, and it has initiated a number of regional conventions to protect heavily polluted marine seas. The most advanced of these is the Convention for the Protection of the Mediterranean Sea Against Pollution, which was brought into force in February 1978, 2 years after it was signed at Barcelona, Spain.

The solution to worldwide ocean pollution problems must come from cooperative action among the maritime and coastal nations. Uniformly stringent global standards are a goal of the future. Implementation of the standards, however, will remain the responsibility of the sovereign states. It is unlikely that enforcement authority will be delegated to an international organization in the foreseeable future. Some states that feel while uniformity among nations is a desirable goal, international agreements on pollution control and environmental standards tend to seek the level of the lowest common denominator. The conventions administered through the Inter-Governmental Maritime Consultative Organization are cases in point. The effectiveness of the pollution convention, for example, has been criticized because the standards of the international agreement are less stringent than the U.S. standards.[24] More recently, IMCO has formed a Marine Environment Protection Committee, which has improved its effectiveness. Although international agreements are, by necessity, compromise or consensus settlements, they are often one of the most effective means of protecting the world's environment. Recent examples of effective international agreements regarding marine environmental protection are the 1973 International Convention for the Prevention of Pollution from Ships (1973 MARPOL), the 1974 International Convention for the Safety of Life at Sea (1974 SOLAS), and the Protocols to both of these Conventions resulting from the 1973 International Conference on Tanker Safety and Pollution Prevention. These agreements were developed under the auspices of IMCO.

Governmental Efforts to Control or Mitigate Marine Pollution

The United States was among the first nations to recognize the potential danger of marine pollution. Congress acted early using the commerce clause of the Constitution to regulate and protect the public waters. Recognizing that the growth in urban areas during the 1870s and 1880s produced noticeable pollution in the harbors of many northeastern cities, the Congress enacted the first pollution statute, the Act of June 29, 1888, for the purpose of barring

[23] Ibid., p. 40.

[24] Richard Frank, "Environmental Consequences of Deep-Sea Mining," in *Law of the Sea: Conference Outcomes and Problems of Implementation*, Edward Miles and John K. Gamble, Jr. (eds.). Cambridge, Mass., Bollinger Publishing Co., 1977, 452 p.

discharges in New York City's harbors.[25] An extended version of the Act of 1888, the River and Harbor Act of 1899 (33 U.S.C. 401 et seq. (1964)), popularly called the Refuse Act, outlawed the dumping of refuse material into any navigable water or its tributary. This Refuse Act served as one of the primary water quality statutes protecting coastal waters from 1899 until 1972. It was based on the theory of "navigational servitude," which requires that waters be kept free of debris that would impede navigation. Prevention of visible pollution and impediments to navigation were the primary concerns of Federal law until the late 1940s when the first actual water quality statute aimed at treatment was enacted.

Federal Marine Pollution Control Statutes

Oil Pollution Act of 1924 (Public Law 68–238)—33 U.S.C. 431 et seq. (Supp. 1970). This Act prohibited oil disposal in navigable waters except in emergencies or unavoidable accidents, or by regulation. Authority was vested in the Secretary of the Army. (Act replaced by Sec. II Water Quality Improvement Act of 1970);

Water Pollution Control Act of 1948 (Public Law 80–845)—33 U.S.C. 1151 et seq. This Act was a 5-year authorization and was the precursor of the present body of laws pertaining to water pollution. It established a technical assistance program to States for the development of water quality control facilities;

Federal Water Pollution Control Act of 1956, as amended in 1961, 1965, 1966, 1970, 1972, and 1977 (Public Law 84–660)—33 U.S.C. 1151 et seq. This Act serves as the basis for our national water cleanup initiative. It provides State and interstate water pollution control agencies with construction and other grants, enforcement procedures, and interstate waters and research programs. It authorizes a 5-year grant program to municipalities for construction of sewage treatment plant facilities.[26]

- The 1961 amendments increased funding levels; authorized seven field laboratory and research facilities; directed studies, research, and development on the quality of the Great Lakes; and extended Federal enforcement authority to navigable waters.
- The 1965 amendment (The Water Quality Act of 1965 (Public Law 89–234), (33 U.S.C. 1151 et seq.)) provided for Federal administrative reorganization and further grants for research, development, and construction of sewage treatment works. It created the Federal Water Pollution Control Administration (FWPCA) in the Department of Health, Education, and Welfare. It instituted the program of mandatory water quality for interstate waters.
- Reorganization Plan No. 2 of 1966 transferred the FWPCA to the Secretary of the Interior. The Plan provided for an Assistant Secretary of the Interior to assist the Secretary in carrying out the transferred functions.
- The 1966 amendments (The Clean Water Restoration Act of 1966), (33 U.S.C. 431–437, 466a, 466–l, to 466e, 466q, 466j, 466l–466n) extended the definition of coverage of the Act to include specifically rivers, coastal waters, sounds, estuaries, bays, and harbors. Massive Federal support was authorized for grants for the construction of sewage treatment facilities. The 1966 amendments also authorized a 3-year study of the pollution of the Nation's estuary system.
- Title I of Public Law 91–224 (33 U.S.C. 1151, 1152, 1155–1156, 1168, 1160–1175), the Water Quality Improvement Act of 1970, further amended the FWPCA Act. It repealed the Oil Pollution Act of 1924 and renamed the FWPCA The Federal Water Quality Administration. It provided for better control of oil pollution, control of sludge from vessels, identification of hazardous substances, grants for acid mine drainage control demonstration projects, training funds, and additional funding for national estuary studies.
- Reorganization Plan No. 3 of 1970 combined several agencies dealing with water pollution control within the Environmental Protection Agency in the Water Quality Office. Today water programs are combined with hazardous material controls to form the Office of Water and Hazardous Materials.
- During the 92d Congress, awareness of the problems of water quality continued to heighten, litigation increased, and the permit program instituted under the Refuse Act of 1899 essentially broke down. Finally, the 92d Congress enacted the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), which completely revised water pollution legislation. It based water pollution control primarily on effluent limitations instead of on water quality standards. It emphasized comprehensive planning and addressed for the first time nonpoint source pollution. The ultimate goal as stated in the Act was "to restore and

[25] U.S. Congress, Senate, Committee on Commerce, Science, and Transportation and the National Ocean Policy Study. *Congress and the Oceans: Marine Affairs in the 94th Congress.* 95th Cong., 1st sess. Washington, D.C., Government Printing Office, 1977.

[26] 33 U.S.C. 1251(a), (P.L. 92–500, Sec. 101).

maintain the chemical, physical, and biological integrity of the Nation's waters."

Implementation of the Federal Water Pollution Control Act has been plagued with numerous problems for Federal, State, and local administrators, the courts, and the Congress.[27,28] Among the problems encountered were restrictions on funds available (50 percent of the originally authorized monies were impounded during the fiscal years 1973, 1974, and 1975), difficulties over the allocation of funds to the States, problems of individual States and municipal authorities in establishing charges for waste treatment, and debates that arose with relation to the application of FWPCA where States were discharging partially treated sewage directly into ocean waters. The rationale for coastal cities to use ocean outfalls was that the bases for treatment and practices were developed relative to the protection of inland waste waters and that ocean waters had different absorption characteristics.[29]

The Clean Water Act of 1977. This Act amended FWPCA of 1972. It extended the deadlines for achieving best practical and best available treatment technology. The deadline for control of discharges of toxic substances into waterways was extended to 1984. It provided for increased funding of construction grants for sewage treatment plants. The Act amended Section 404 permitting procedures and exempted Federally funded and constructed projects in navigable waters. The pollution control zone of contiguous waters was extended to 200 miles under prescribed circumstances.

Oil Pollution Act of 1961—33 U.S.C. 1001–1015. This act provided for regulation of vessel discharge of oil or oily mixtures. It also established construction standards for tankers and provided enforcement authority and penalties for violations. Authority was vested with the Secretary of Transportation.

Estuarine Areas Act—16 U.S.C. 1221–26. This Act was intended to provide a means for considering the need to protect, conserve, and restore estuaries while maintaining a balance between protection and development. It directed the Secretary of the Interior to make an estuarine study and inventory.

National Environmental Policy Act (NEPA)— 42 U.S.C. 4321–4347. NEPA is a general purpose environmental statute which requires that environmental impacts be assessed and considered for all Federal activities that "significantly affect the quality of the human environment." It is probably the most litigated environmental statute enacted thus far.[30] With its requirements for environmental impact statements for major Federal actions significantly affecting the environment, the clear intent of NEPA is to force the involved agency to assess impacts of its actions before committing itself to them. Through the EIS process, NEPA also allows for other agency and general public input to decision making, because the EIS is one of the documents used by the decision maker.

The Marine Protection, Research, and Sanctuaries Act of 1972 (Public Law 92–532)—33 U.S.C. 1401 et seq. This statute is popularly known as the Ocean Dumping Act. Title I provides for EPA regulation of dumping activities, Title II for initiating a comprehensive research program by the Secretary of Commerce in coordination with the Administrator of the Environmental Protection Agency and the Secretary of the department in which the Coast Guard is operating, and Title III for designation of marine sanctuaries by the Secretary of Commerce. (For a detailed discussion see section on Ocean Dumping which follows.)

The Coastal Zone Management Act—16 U.S.C. 1451–1464. This Act is aimed at ensuring effective management, beneficial use, protection, and development of the coastal zone. It gives authority to the Secretary of Commerce to provide planning and administrative grants to encourage State and local governments to establish coastal management programs. (For a detailed discussion see Chapter IV.)

Ports and Waterways Safety Act of 1972 (Public Law 92–340)—33 U.S.C. 1221–1227. The Act, in order to prevent the damage or destruction of vessels or structures on or in the navigable waters of the United States or area immediately adjacent to those waters, and to protect these waters and resources therein from environmental harm resulting from vessel or structure damage, destruction, or loss, authorized the USCG to establish vessel traffic services applicable to all vessels, in order to prevent damage or destruction of vessels or structures on or in navigable waters. The emphasis is placed on ports, harbors, or other waters that are subject to congested vessel traffic or are determined to be especially hazardous. Regarding vessels carrying certain cargoes in bulk, Title II authorizes regulations concerning vessel design, construction, and equipment for prevention and mitigation of damage to the marine environment.

Intervention on the High Seas Act (Public Law 93–248)—33 U.S.C. 1371–87 (Supp. IV 1974). This Act authorizes the Coast Guard (on the high seas) to prevent, mitigate, or eliminate harmful effects of an

[27] U.S. Congress, op. cit. note 25.
[28] U.S. Comptroller General. *Implementing the National Water Pollution Control Permit Program: Progress and Problems.* Washington, D.C., General Accounting Office, 1976, 187 pp.
[29] Ibid., p. 6.
[30] Environmental Law Institute. *The Evolution of National Wildlife Law.* Prepared for the Council on Environmental Quality. Washington, D.C., 1977, 485 pp.

oil spill when it poses a threat to the coastline or related interests of the United States.

The Deepwater Port Act of 1974 (Public Law 93–627)—33 U.S.C. 1501–1524. One purpose of the Deepwater Port Act of 1974 is to "authorize and regulate the location, ownership, construction, and operation of deepwater ports in waters beyond the territorial limits of the United States." In many ways it is a model of the "newer" approach to the siting—particularly the licensing component—of energy facilities. Some key features are:

- Coordination. The law designates the Department of Transportation as the "lead agency" for licensing deepwater ports outside of the 3-mile zone. In addition, it clearly lists the jurisdictions and responsibilities of the various Federal agencies involved and establishes specific procedures and deadlines for coordinating their actions. The statute also provides for an unusual but clearcut way of coordinating State and Federal viewpoints: no Federal license shall be issued without the approval of the governor of each adjacent coastal State.
- Performance standards. The law sets forth the conditions that must be met before the Secretary of Transportation may issue a license (it must be in the national interest, meet environmental criteria, meet antitrust requirements, etc.) and also directs the Secretary to prepare environmental review criteria to be used in evaluating applications.
- Public participation. The Act explicitly provides for public access to information about the applications, for public hearings, and for judicial review and citizen civil action.

Ocean Dumping

During the 1950s and 1960s, ocean dumping reached proportions that caused considerable public concern. At that time, what limited regulation existed was carried out under the authority of the New York Harbor Act of 1888, which gave the Secretary of the Army power to prohibit disposal of waste except for that flowing from streets and sewers into the harbors of New York, Hampton Roads, and Baltimore. Also in effect was the Refuse Act of 1899, which prohibited dumping in navigable waters where it would impede navigation. The increasing use of the ocean for waste disposal during the past two decades is related to increasing coastal land values, growing population, industrial growth, and the trend toward secondary and tertiary sewage treatment that result in large quantities of sludge and toxic residues. The ocean was mistakingly viewed as a panacea—a "safe" disposal site totally capable of diluting and absorbing harmful materials.

In 1970, the problem of indiscriminate waste disposal in the marine environment was formally recognized as a growing problem. In that year the Council on Environmental Quality (CEQ) reported to the President on environmental problems associated with ocean dumping.[31]

The report recommended a comprehensive policy on ocean disposal that would regulate dumping and prohibit disposal of certain materials harmful to the marine ecosystem. The report included an inventory of dumpsites, types of environmental effects, governmental jurisdictions, and related international aspects. CEQ specifically addressed the disposal of polluted dredged materials, sewage sludge, and industrial wastes. It recommended that dumping of polluted dredge material be phased out as adequate alternatives were developed. The report reemphasized the Corps of Engineers' policy of dredging heavily polluted areas only when necessary and after weighing navigational benefits against potential environmental damages. CEQ recommended that: (1) dumping of undigested sewage sludge be stopped, (2) dumping of digested and other stabilized sludge be phased out, (3) no new sources be allowed, and (4) any necessary continued dumping in cases where substantial facilities and/or significant commitments existed be considered an interim measure until suitable alternatives were developed and implemented. With regard to industrial wastes, CEQ recommended that dumping be stopped as soon as possible and that dumping of toxic wastes be stopped immediately unless there are no alternatives less harmful to man and the environment.

CEQ and the increasing public awareness of the potential undesirable effects of waste disposal in the marine environment were largely responsible for the enactment of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA).

Marine Protection, Research, and Sanctuaries Act of 1972

The MPRSA, Public Law 92–532 (33 U.S.C. 1401–44, as amended, 16 U.S.C. 1431–34), contains three major titles. Title I sets out the primary regulatory framework for ocean dumping. It authorizes EPA to issue permits for ocean disposal of nondredged waste materials and the Corps of Engineers to issue permits for disposal of dredged material, and it provides for penalties for violations of permit conditions. The U.S. Coast Guard is directed to enforce the provisions of MPRSA. Under this title, all ocean

[31] U. S. Council on Environmental Quality. *Ocean Dumping: A National Policy*. Washington, D.C., Government Printing Office, 1970, 45 pp.

dumping is prohibited except when authorized by permit, and disposal of certain types of wastes flatly prohibited (radiological, chemical, and biological warfare agents, and high-level radioactive wastes). Permits for other substances are granted if it can be determined that "such dumping will not unreasonably degrade or endanger human health, welfare or amenities, or the marine environment, ecological systems or economic potentialities." The question of what constitutes unreasonable degradation is left to the judgment of EPA and the Corps.[32]

Section 102 authorizes EPA to issue several classes of permits, including general, special, emergency, interim, research, and incineration at sea: *general*—small quantities having minimal adverse environmental effects; *special*—dumping materials which satisfy the criteria for a duration of 3 years; *emergency*—materials posing an unacceptable risk to human health and for which there is no disposal alternative; *interim*—may be issued up until April 23, 1978, for materials not in compliance with the criteria and only from facilities with a history of ocean dumping; *research*—dumping when scientific merit outweighs potential environmental hazards; *sea incineration*—such things as organic chloride wastes, wooden materials, derelict vessels.

The Corps permits issued under Section 103 for dredged material disposal are subject to EPA criteria as well as an independent evaluation by the Corps. EPA and the Corps have jointly developed an implementation manual for ecological evaluation of proposed disposal of dredged material into ocean waters.

The International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, which was adopted in November 1972, is closely alined philosophically with the intent of MPRSA. The Convention, fully effective in August 1975, aims to regulate dumping from vessels, aircraft, and manmade structures. It prohibits dumping of certain persistent toxic materials, as well as high-level radioactive wastes and biological and chemical warfare agents. Ocean dumping regulations issued by EPA are consistent with the Convention.

Under Title I, Section 107(c) of MPRSA, the Secretary of the Department under which the U.S. Coast Guard (USCG) is operating shall provide ocean dumping surveillance and appropriate enforcement activity to prevent unlawful transportation of material for dumping or unlawful dumping. Such enforcement includes safe transportation, handling, storage, stowage, and carriage. Section 108 authorizes the Secretary of the Army, the Administrator of EPA, and the Secretary of the department under which the USCG is operating to issue regulations for carrying out their responsibilities under the Act. The Coast Guard's primary activities under MPRSA are directed at surveillance of toxic materials and spot checks of nontoxic dumps. Lowest priority exists for dumping associated with Federal dredging projects (not requiring permits), which represent more than 85 to 90 percent of all U.S. ocean dumping.[33] Surveillance achievements have improved significantly for each of the last 3 years.[34]

Title II of the MPRSA deals with Comprehensive Research on Ocean Dumping and is largely in response to the critical data gaps identified by the 1970 CEQ report. Section 201 requires the Secretary of Commerce, in coordination with the Secretary of the department under which the Coast Guard is operating and the Administrator of EPA, to undertake a research and monitoring program dealing with effects of ocean dumping. An annual report to the Congress must include an evaluation of short-term ecological and socioeconomic effects.

Section 202 requires the Secretary of Commerce, in consultation with other Federal agencies, to initiate a research program dealing with long-term effects of pollution, overfishing, and other man-induced changes in ocean ecosystems, and also requires an annual report to the Congress. Section 203 calls for research on ending or minimizing all ocean dumping by 1978, and also is the responsibility of the Secretary of Commerce. Title III authorizes the Secretary of Commerce, after consultation with the Secretaries of State, Defense, Interior, and Transportation and the Administrator of EPA, to designate areas of the Continental Shelf and the Great Lakes as marine sanctuaries in order to preserve or restore such areas for their recreational, conservation, ecological, or esthetic values.

Status of Ocean Dumping

Dredged Material

Dredge material by weight is the most significant material being disposed of in the oceans. The amount dumped annually constitutes over 90 percent of total waste disposed of in the marine environment. The amount of spoil requiring ocean dumping (about 30 to 40 percent) has increased over the years. It has been estimated that over the past years polluted dredged wastes constitute at least one-third of the total waste dumped. [35,36,37]

---

[32] U.S. Congress, Senate, Committee on Commerce. *Ocean Dumping Regulation: An Appraisal of Implementation.* Washington, D.C., Government Printing Office, 1976, p. 89.

[33] U.S. Congress, op. cit. note 32.

[34] Department of Transportation Report to Congress on Ocean Dumping Activities for 1976.

[35] U.S. Department of Commerce, NOAA. *Report to the Congress on Ocean Pollution, Overfishing, and Offshore Development—July 1975 through September 1976,* Washington, D.C., Government Printing Office, November 1977.

[36] United Nations, Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP). Scientific Criteria for the Selection of Sites for Dumping of Wastes Into the Sea. Reports and Studies No. 3, 1975, p. 21.

[37] National Academy of Sciences—National Research Council. *Disposal in the Marine Environment: An Oceanographic Assessment.* Washington, D.C., 1976, p. 76.

In calendar year 1976, there were 32 active Section 103 disposal permits and the Corps of Engineers undertook 72 authorized projects.[38] The Corps' dredging activities are exempted by MPRSA, although it is required by regulation to apply the same criteria to its projects as required for the Section 102 permit applications.

In 1975, 95 permits were issued, of which 42 were holdovers from 1974. There were no denials of permits by the Corps during fiscal years 1974 and 1975.[39] In calendar year 1976, 65.5 million cubic yards (93.8 million tons) of dredge material were dumped in marine waters. While this represents a decline over previous years, it probably does not indicate a long-term decreasing trend in the amount of annual dredged material being deposited in the oceans. In the last 4 years, the amount appears to remain fairly constant. The Gulf of Mexico (49 percent of 1976 material) is the most active region overall; the Atlantic Region (33 percent) is the second most active. The New York Bight was the most active site nationwide. Over 90 percent of 1976 material was dumped off the coasts of 10 States (Washington, Oregon, California, Texas, Louisiana, Florida, Georgia, S. Carolina, N. Carolina, New Jersey) and over 55 percent of the material was deposited beyond the 3-mile territorial sea.[40] (For a discussion of dredge and fill regulations under Section 404 of the Federal Water Pollution Control Act Amendments, see Chapter IV.)

Sewage Sludge and Ocean Outfalls

Sewage sludge disposal presents a different picture. It is now limited to the Atlantic region, where the amount disposed is increasing slightly. The increase is due to a rise in population as well as the requirement for secondary sewage treatment, which yields more sludge. The Atlantic area has failed to develop alternatives to ocean disposal and shows a historical usage of this method of disposal due to lack of availability of onshore dumpsites and cost factors. The New York/New Jersey metropolitan region, Philadelphia, and Camden are using three active sites. One is in the New York Bight apex (7.2 million cubic yards in 1974 [41]), one is 90 miles east of Cape May, and one is about 50 miles southeast of the mouth of the Delaware Bay.[42] Philadelphia's third interim permit, issued in February 1975, contains a mandatory phase-out to eliminate this ocean dumping by January 1, 1981. New York City's dumping is to end December 31, 1981. Camden, N. J., was operating under an emergency permit issued after a buildup of sewage sludge in tanks was declared a public health hazard. This permit expired at the end of 1977.[43]

Waters of the New York Bight region, already under heavy daily pressure from municipal and industrial wastes as well as massive ocean dumping operations, have significantly declined in quality over the years. In addition to permitted sludge, New York City discharges some 500 million gallons of raw sewage every day through Gateway Park, and about 35 percent of sewage solids for the year are flushed out during rain and do not receive treatment.[44]

Industrial Wastes

Nine ocean sites are designated for industrial waste disposal. These sites receive industrial chemicals, which include such things as hydrochloric acid byproducts; inert ore slurry from titanium dioxide pigments; residues from galvanizing and plating operations; liquid wastes from textile manufacturing, etching and photographic processes; water solutions of inorganic salts; and other byproducts from various manufacturing processes.[45]

EPA's annual report does not normally list actual constituents of the wastes, thus making it difficult to assess potential effects. Industrial dumping occurs primarily off the Atlantic and Gulf of Mexico coasts —a reflection of population and industrial concentration. In 1976, 2.7 million tons were dumped, with by far the largest amount going into the Atlantic. The amount of industrial waste dumped decreased by about 1 million tons from 1975 to 1976, because five of the seven original permittees found alternative methods of disposal.[46]

Since the Ocean Dumping Act was enacted, EPA has authorized dumping through interim permits where no feasible alternative existed. Most of EPA's assessments have dealt with the *availability* of alternative disposal methods rather than the potential adverse effects of all alternatives. One criticism has been that the agency has forced adoption of alternatives to ocean dumping without weighing the effects. The other side of the issue is the criticism that issuing interim ocean dumping permits allows discharge of wastes that may be harmful and that may contain higher levels of toxic materials than would normally be permitted.[47]

[38] U.S. Army Corps of Engineers. *1976 Report to Congress on Administration of Ocean Dumping Activities.* Washington, D.C., Government Printing Office, 1977, p. 66.
[39] U.S. Congress, op. cit. note 32, p. 89.
[40] U.S. Army Corps of Engineers, op. cit. note 38.
[41] U.S. Congress, op. cit. note 32.
[42] U.S. Army Corps of Engineers, op. cit. note 38.
[43] U.S. Congress, House, Committee on Merchant Marine and Fisheries. *NACOA—Sea Grant—Ocean Dumping.* Hearing before Subcommittees of the House Committee on Merchant Marine and Fisheries, 94th Cong., 1st sess. Washington, D.C., Government Printing Office, 1977, p. 587.
[44] U.S. Congress, op. cit. note 32.
[45] U.S. Department of Commerce, NOAA. *Report to the Congress on Ocean Dumping Research January through December 1975.* Washington, D.C., Government Printing Office, 1976, p. 33.
[46] U.S. Congress, op. cit. note 32, p. 49–52.
[47] Ibid.

Before enactment of the Ocean Dumping Act, organochlorine wastes were disposed of on land, in the ocean, or by land incineration. The Act prohibited ocean dumping except in trace amounts. As a result, interest in incineration at sea has developed. Before 1974 EPA concluded that the Ocean Dumping Act did not apply to incineration, but in September 1974 the agency reversed itself and asserted jurisdiction. In 1974, Shell Chemical Co. was issued research permits for ocean incineration. A subsequent EPA report on the trials concluded that ocean incineration was an environmentally sound disposal method, compatible with the Act, and is now being permitted.[48,49]

Research and Monitoring Under the Ocean Dumping Act

The 1970 CEQ report on ocean dumping indicated serious information gaps. The areas of needed research were identified:

- pathways of waste materials in marine ecosystems;
- basic chemical and physical processes in the oceans;
- identification of toxic chemicals and data on lethal, sublethal, and chronic long-term impacts on marine organisms;
- identification of marine pathogens;
- development of alternatives to ocean dumping;
- development of national and international pollution monitoring systems.[50]

The Ocean Dumping Act of 1972 provided authority for undertaking the necessary research. NOAA and EPA are authorized under this Act to conduct related research:

NOAA. Section 201.—Comprehensive and continuing programs of monitoring and research on short-term ecological effects of dumping waste materials into the ocean and the Great Lakes, in coordination with the Secretary of the Department in which the Coast Guard is operating and the Administrator of the EPA. Section 202—Long-range effects of pollution, overfishing, and other man-induced changes to ocean ecosystems, in consultation with other appropriate Federal departments and agencies. Section 203—Research aimed at ending or minimizing all ocean dumping within 5 years of the effective date of the Act (alternative research).

EPA. Necessary research to provide for an ocean dumping permit system.

The Corps of Engineers lacks legislative authority for research under the Act, however, it is engaged in related investigations under the 1970 Dredged Material Research Program, a provision of the Rivers and Harbors Act of 1970. Part of the Corps research objective is to provide definitive information on environmental impacts of disposal operations and the development of disposal alternatives, including consideration of dredge material as a manageable resource.[51] The Maritime Administration is also involved in work related to Section 203—development of a U.S. flag capability to incinerate toxic chemical wastes at sea.

NOAA's current program of ocean dumping research has two major elements: (1) the National Ocean Survey (NOS) Ocean Dumping Program and (2) the related research being conducted by the Marine Ecosystems Analysis (MESA) New York Bight Project. NOS carries out NOAA's responsibilities under the terms of the March 1975 EPA/NOAA Interagency Agreement Regarding Ocean Dumpsite Investigations.

NOS is now involved in four major areas of investigations: (1) industrial waste deepwater dumpsites in the Gulf of Mexico, (2) deepwater dumpsite 106, (3) dumping of pharmaceutical waste off Puerto Rico, and (4) dredge material dumpsites in the Mississippi River Delta area.

A NOAA/Corps of Engineers interagency agreement is in preparation and should be completed early in 1978. The agreement will ensure that NOAA's efforts under Title II will also provide information needed by the Corps for dumpsite evaluation and management required under Title I.

A third interagency agreement between NOAA and the Coast Guard will also be executed early in 1978. It will ensure that NOAA's programs of monitoring and research, while aiding in fulfillment of NOAA's Title II mandate, will also provide information required by EPA for site evaluation and management, and will provide for a NOAA/USCG coordination in a program of monitoring ocean disposal sites.

The MESA New York Bight Project began field work in 1973. Project objectives include descriptions of the New York Bight ecosystem and areas near existing and proposed dumpsites, and determination of the occurrence, fate, and effects of pollutants entering the Bight.[52,53] MESA long-term studies include:

- chemical and mineralogical composition of pollutants and their interactions with seawater;
- seasonally occurring low-density, carbon mud patches off Long Island—their derivation and movement;
- remote surveillance and monitoring; and
- usefulness of various sensing and interpretative techniques.

[48] U.S. Congress, op. cit. note 32.

[49] U.S. Environmental Protection Agency, *Ocean Dumping in the U.S.*, 1970.

[50] U.S. Council on Environmental Quality, op. cit. note 31.

[51] U.S. Army Corps of Engineers, op. cit. note 38.

[52] U.S. Congress, op. cit. note 32.

[53] U.S. Department of Commerce, National Oceanic and Atmospheric Administration. *Report to the Congress on Ocean Pollution, Overfishing, and Offshore Development, July 1975 through September 1976.* Washington, D.C., Government Printing Office, November 1977.

In 1975 the MESA project also assisted EPA in assessing alternative sewage sludge dumpsites in the Bight.

Since 1971, NOAA's National Marine Fisheries Service laboratory at Milford, Conn., has conducted research on the behavior of heavy metals in seawater. Objectives are to determine how heavy metals affect several different organisms at various life stages, and under varying exposure times and environmental conditions.

In addition, NOAA's Office of Sea Grant sponsors a very limited amount of marine research related to ocean dumping and disposal of dredge material. (See Chapter VII, Marine Science and Technology.)

In support of the mandates of the Dumping Act, EPA conducts research on ecological effects and alternative methods of disposal and is a participant with NOAA in baseline and monitoring surveys of dumpsites. Research on ecological effects is focused on improving bioassay techniques and methods of predicting and assessing impacts. In fiscal year 1976, Congress allocated additional money to EPA for research in the area of ocean disposal; as a result, new studies were initiated and the level of in-house support increased. In 1976, the agency was engaged either directly or by contracts in 13 separate projects on ocean waste management research.

EPA conducts research on alternative disposal methods under legislative authorities other than the Dumping Act. Information on the effects of all variable waste disposal alternatives is necessary to determine the optimum disposal method. Research on alternative disposal methods sponsored by EPA includes impact of alternative methods, resource reuse or recovery, detoxification, and ocean incineration. Some of the alternative methods being considered are sludge use, composting, and pyrolysis.

Since 1974, EPA's Office of Radiation Programs has surveyed three of the four radioactive waste dumpsites used from 1946 to 1970 in the Pacific and Atlantic, although the United States no longer disposes of these wastes in the ocean. The United States is now evaluating all alternatives, including ocean disposal, for disposal of radioactive wastes. Survey data from the old sites are therefore quite valuable.[54]

EPA requires baseline survey data and evaluations of existing and proposed disposal sites for assessing and predicting environmental effects of ocean disposal, and for preparing Environmental Impact Statements under NEPA. In response to this need, an EPA/NOAA Interagency Agreement dealing with the conduct of dumpsite evaluations is now in effect. Signed in March 1975, it delineates agency responsibilities for the necessary evaluations.[55]

Surveys are currently being made in 12 municipal and industrial dumpsites; 8 in the Atlantic; 1 off Puerto Rico; and 3 in the Gulf of Mexico.[56] Aside from a few cooperative studies and one formal interagency agreement dealing with dumpsite surveys and monitoring, both EPA and NOAA pursue dumping research independently within their own agencies' objectives. The management coordination for research under the lead agency concept put forth in Title II has not been achieved or even attempted.

Progress and Issues

EPA has been criticized by some as being too lenient and by others as being too stringent in administering the Ocean Dumping Act. Progress has been made toward alleviating ocean dumping, but problems still remain in the implementation of almost every aspect of the Act. The initial problem is with the misunderstanding about the intent of the Act. Are we to phase out and discontinue ocean dumping, or do we continue it as a viable alternative under adequate supervision and regulation? The uncertainties of this unanswered question are reflected throughout the program, both in regulation and research.

There are those in the scientific community who feel that from the standpoint of eutrophication the use of ocean outfalls for sewage discharge may be preferable to secondary treatment.[57]

The Officer and Ryther study concludes that the eutrophication potential may be enhanced with secondary treatment, since organic nutrients will be more readily available to phytoplankton than would be the case with natural decomposition from sewage outfalls. Even so, use of outfalls would necessitate close attention to pathogens and trace contaminants.

Major revisions to the Ocean Dumping Regulations and criteria were promulgated in 1977. Dredged materials are now governed by the same criteria as other substances, and an assessment of alternative disposal methods is a part of the permit application evaluation.

Environmental impact statements are now being prepared for ocean dumping with the Gulf Ocean Incineration Site as the first formally designated ocean dumping site.[58]

One of the controversies surrounding the program involve EPA's use of interim permits that allow the temporary dumping of harmful wastes that ex-

[54] U.S. Environmental Protection Agency, op. cit. note 49.

[55] EPA/NOAA Interagency Agreement concerning baseline surveys and evaluations of ocean disposal sites, under the MPRSA.

[56] U.S. Environmental Protection Agency, op. cit. note 49.

[57] C. B. Officer and J. H. Ryther. "Secondary Sewage Treatment Versus Ocean Outfalls: An Assessment," *Science* 197: 1056–1060, 1977.

[58] U.S. Environmental Protection Agency, op. cit. note 49.

ceed trace level requirements, e.g., dumping of sewage sludge by New York City and Philadelphia. The criticism is that the Act provides no basis for such a permit and that its use does not conform with the intent of Congress. Time may make this controversy moot since the Final Regulations and Criteria on Ocean Dumping, issued by EPA in January 1977, state that interim permits will be phased out by December 31, 1981. It remains to be seen, however, whether New York City and Philadelphia will have a viable disposal alternative by that time, or whether the interim permit will simply be exchanged for an "emergency permit" as was the case with Camden, N. J. The Congress might also choose to step in; H. R. 4715 would authorize interim permits until December 31, 1981. This bill is expected to be considered during the second session of the 95th Congress.

A second problem involves the effectiveness of EPA's criteria for assessing material to be dumped, particularly the bioassay tests. EPA has revised its criteria and provided added opportunity for public input by way of the EIS process, but accurate and relevant knowledge from research, and corresponding criteria revision, will be the only means of solving this problem.[59,60]

Enforcement continues to be a serious concern. The Coast Guard's objective is to monitor 75 percent of dumping activities at mixed industrial waste sites and 10 percent of the remaining operations. In 1977, 72 percent surveillance in the first area and 22 percent in the second area were achieved. Overall surveillance techniques still concentrate on validating permits; examining logs, records, and geographic position of the actual dumps; and investigating failures to notify the Coast Guard in advance of departure (411 of the 422 violations in 1976 were of this last type).[61] EPA surveillance includes extensive sampling of representative dump loads.

Among the major problems confronting research related to the Dumping Act is the lack of resources and coordination. Section 202 of the Act gave NOAA the lead responsibility for initiating a comprehensive coordinated research program on long-term effects of pollution in the oceans. To date, this requirement has not been met, partly because resources were not available and partly because the lead agency mandate and the necessary authority to execute were not explicitly stated in the Act; nor, until recently, has NOAA aggressively pursued the implementation of the intent of Section 202.

An overall coordinated program has not been structured, and, as a result, data gaps and duplication of effort remain obvious 5 years after enactment of the Dumping Act. Research continues to be incohesive and without coordinated national planning. NOAA carries out some research on long-term effects of modifications to ocean ecosystems; however, this research is funded under various laws for programs predating MPRSA. As a result, no integrated program within NOAA addresses the concerns of Section 202.

Through 1976, the Department of Commerce budget requests did not include Section 202 funding. In 1978, the Department made a minimal request, but no funds were appropriated. Fiscal year 1979 budget requests again include funding for Section 202 implementation.

NOAA is currently preparing a Program Development Plan to be completed in 1978 for implementation of Section 202. The plan will propose a management framework within which Federal research can be actively coordinated and oriented toward national objectives on long-term effects. The program will seek to eliminate duplication of effort and to provide information in a problem solving mode. Implementation of this plan depends on aggressive leadership and the ability to justify the expenditure of the needed resources. New legislation, S. 1617, the Ocean Pollution Research and Monitoring Program Act, would provide for a coordinated program. It has now become law.

Similar problems exist in Section 201 responsibilities. A Program Development Plan for implementation of Section 201 was completed in August 1976.[62] It integrated all NOAA programs related to ocean dumping efforts, specifying coordination of NOAA efforts as a key element of an effective program. Owing to lack of resources, the plan has not been implemented as proposed. Instead, efforts have been concentrated on fulfilling NOAA's responsibilities under the EPA/NOAA interagency agreement.

In fiscal years 1974 and 1975, Section 201 funds were not requested by either NOAA or the Department of Commerce. In fiscal year 1976, NOAA's requested funds were cut by the Department—funding was not requested by the Administration, and none was appropriated. Finally, funds were appropriated in 1977 and 1978.

Funds to implement Section 203 were requested by NOAA, but deleted by the Department of Commerce. In recent years, EPA and the Corps of Engineers have carried out research on alternatives that has been responsive to requirements of the Dumping Act. At the present time, Congress is considering the transfer of Section 203's authority from NOAA to EPA as proposed in H.R. 4715.

[59] U.S. Congress, op. cit. note 32.

[60] U.S. Congress, House, Committee on Merchant Marine and Fisheries. *Hearings on Ocean Dumping Oversight.* Washington, D.C., Government Printing Office, 1977.

[61] U.S. Environmental Protection Agency, op. cit. note 49.

[62] U.S. Department of Commerce, NOAA. Program Development Plan for Ocean Dumpsite Research and Monitoring Program, 1976.

Funding for alternative research by EPA and the Corps has not been a result of appropriations for the Dumping Act, but from other legislative authorities. Although Section 203 specifies the Department of Commerce as the lead agency, NOAA has deferred this responsibility to EPA where facilities, expertise, and a history of this type of research exist.

The Maritime Administration (MarAd) is also involved in alternative research. There is a current plan to support the development of a U.S. flag capability to incinerate toxic chemical wastes at sea. A Final Environmental Impact Statement has been prepared describing this MarAd Chemical Waste Incinerator Ship Project. This Project is in harmony with Section 203 of the 1972 Ocean Dumping Act. Recently, MarAd contracted out the preparation of "Study of the Economics and Environmental Viability of a U.S. Flag Toxic Chemical Incineration Ship."

Oil and the Marine Environment

Introduction

Oil finds its way into the marine environment through both natural pathways and human accidents. The total annual input of petroleum hydrocarbons to the world's ocean has been estimated to be as much as 6 million metric tons.[63] Of this amount, over 35 percent results from ship and tanker operations; 1.9 million metric tons (31 percent) from river and urban runoff; 0.8 million metric tons (13 percent) from coastal refineries, and industrial and municipal wastes; 0.6 million metric tons (9.8 percent) each from atmospheric fallout and natural seeps; and 0.08 million metric tons (1.3 percent) from offshore oil production.

Ship and tanker operations together with river and urban runoff account for nearly two-thirds of the petroleum hydrocarbons entering the marine environment. Tanker transportation will continue to play an important role in the U.S. petroleum distribution system, particularly in moving crude oil from Alaska and in moving oil products from Gulf Coast refineries to East Coast consumers. In the foreign trade, regardless of the outcome of the Federal government's efforts to reduce foreign energy dependence, U.S. waterborne petroleum imports are likely to remain substantial for some years to come.

In 1975, more than 43 percent of the 749 million short tons (679.5 million metric tons) of U.S. waterborne traffic was accounted for by petroleum and petroleum products.[64] In 1975, U.S. oil import levels averaged slightly over 6.0 million barrels per day—the same level that is now the goal of the Administration's energy program to reduce oil imports. By 1976, oil imports had increased to 7.3 million barrels per day. Some energy analysts are of the opinion that the 6.0 million barrels per day goal for 1985 is not likely to be attained and that 1985 oil imports, even with optimistic assumptions, will likely be between 10 and 12 million barrels per day.[65] Under these circumstances, waterborne petroleum carriage requirements would be substantially larger.

In response to the rapid expansion in both the quantity of oil moving in international commerce and the average distances involved, the world tanker fleet registered a more than eight-fold increase in aggregate capacity over the 20-year period 1955–75. From 1955 to 1965, the capacity of the fleet more than doubled, rising from 42 million deadweight tons to 93 million deadweight tons. From 1965 to 1975, aggregate capacity increased by more than three and one-half times and at the end of 1975 stood at 347 million deadweight tons. [66]

Over this same period, average vessel size also increased dramatically, reflecting the substantial economies associated with large tanker operations, particularly on the longer voyages that have become far more common in recent years. Today it is estimated that the cost of transporting a barrel of oil from the Middle East to the United States aboard a vessel in the 250,000 deadweight ton range is about half the cost of transportation aboard a 50,000 deadweight ton vessel.[67] In response to economic inducements of this magnitude, the average size tanker in the world fleet grew from 15,500 deadweight tons in 1955 to 27,100 deadweight tons in 1965 and to 58,200 deadweight tons in 1975.[68] Supertankers now in service range from 100,000 to 500,000 deadweight tons. More than 116 tankers over 200,000 deadweight tons have been built since 1966. In 1976, supertankers of all sizes represented 55 percent of the world's tanker capacity.

Based on a review of 1973–76 data, about 12,400 polluting incidents are detected annually in the navigable waters of the United States. Of this total,

[63] National Academy of Sciences. *Petroleum in the Marine Environment*. Washington, D.C., 1975, p. 6.

[64] U.S. Army Corps of Engineers. *Waterborne Commerce of the United States*, Part 5: National Summary. Vicksburg, Miss., 1975, pp. 3–11.

[65] U.S. Congress, Senate, Committee on Energy and Natural Resources. *Project Interdependence: U.S. and World Energy Outlook Through 1990 (A Summary Report)*. 95th Cong., 1st sess. Washington, D.C., Government Printing Office, 1977, p. 2.

[66] Sun Shipbuilding and Dry Dock Company, Bulk Ship Product Group. *Analysis of World Tank Ship Fleet—December 31, 1975*. Chester, Pa., November 1976, p. 1.

[67] U.S. Congress, Office of Technology Assessment. *Oil Transportation by Tankers: An Analysis of Marine Pollution and Safety Measures*. Washington, D.C., Government Printing Office, 1975, pp. 23–24.

[68] Sun Shipbuilding and Dry Dock Company, op. cit. note 66, p. 7.

3,338 originate with tank vessels and barges. The quantity of spillage from vessels grew from 9,565.5 metric tons in 1973 to 27,462.7 metric tons in 1976. The major causes of these accidents are structural failures, collisions, and groundings, many due to human error. Tankers deliberately discharge 1 million tons of oil each year worldwide, and some unknown quantity of that in waters off the U.S. coast, in routine operations of ballasting and tank cleaning, although the law now prohibits such practices within 200 miles of the coast unless specifically allowed by the 1954 IMCO Convention.[69] Tankers accidently spill 181,440 metric tons of oil each year worldwide (3.3 percent of total oil input to oceans). As the volume of oil in waterborne commerce increases and larger tankers are constructed to take advantage of the economies of scale, a catastrophic accident would result in a much larger spill, although supertanker casualties from collisions have not yet produced an abnormal number of major spills.

Offshore oil production, which now comprises nearly 20 percent of total domestic oil production, will probably grow in importance. Some studies have indicated that total offshore production may comprise between 25 and 30 percent of total U.S. oil production by 1985.[70] As conventional onshore production peaked and has continued to decline, additional emphasis has been placed on the development of oil and gas in the Outer Continental Shelf to offset increasing domestic demands for energy. It is estimated that between 8 and 50 billion barrels of oil and 28 to 199 trillion cubic feet of natural gas may exist as undiscovered recoverable reserves in offshore areas.[71]

Offshore oil production contributes between 72,570 and 136,080 metric tons of oil per year to the marine environment.[72] The size of spills and annual frequency vary considerably. Although spills may vary from a few gallons to over 150,000, the latter being the amount in the Santa Barbara blowout, most oil spills are small. In 1972, 96 percent were less than 2.4 barrels (100 gallons). A few very large spills accounted for most of the oil spilled. For example, in 1970 and 1972 three spills each year accounted for two-thirds of all oil spilled in the United States in those years.[73] Changes in technology and operating procedures can also affect the probabilities and extent of oil spills from offshore development. One may assume, however, that expanded drilling and production activities off shore will increase the probability of oil spills as development in the frontier areas and in deeper waters of the Continental Shelf and Continental Slope proceeds.

Vessel Source Pollution

Although the River and Harbor Act of 1899 was originally intended to prevent the obstruction of navigation by refuse, it was later held by the U.S. Supreme Court in 1966 to include petroleum released in navigable waters.[74] The first statutory enactment intended to prevent oil releases into the marine environment was the Oil Pollution Control Act of 1924. This was followed by the Oil Pollution Control Act of 1961 (which implemented the 1954 International Convention for the Prevention of the Pollution of the Sea by Oil), the Water Quality Improvement Act of 1970, Federal Water Pollution Control Act Amendments of 1972, the Ports and Waterways Safety Act of 1972, and the Clean Water Act of 1977.

Before 1970, public concern and consequently political interest over oil pollution was small. The grounding and spilling of 72,576 metric tons of oil by the *Torrey Canyon* off the coast of England in 1967 and the Santa Barbara blowout from offshore oil wells in January 1969 dramatically pointed out the potential dangers of oil in the marine environment, as well as the inadequacy of the laws to deal with cleanup and liability.

Federal activity aimed at developing a U.S. capability to prevent and mitigate the effect of such major oil spills accelerated following these incidents. The Federal Water Pollution Control Administration (predecessor to EPA) and the Coast Guard assumed the lead in this activity. Their earlier efforts resulted in a division of effort wherein the Coast Guard accepted responsibility for developing equipment to contain and clean up spills in the offshore areas, while the FWPCA concentrated on cleanup techniques in sheltered waters.

In response to the legislative mandate of the Water Quality Improvement Act of 1970, the Coast Guard promulgated pollution prevention regulations with the intent of reducing the probability of an accidental discharge of oil or oily waste during normal vessel operations, transfer operations, or as a result of certain vessel accidents. The vessel-related portions of the pollution prevention regulations apply to all vessels in U.S. waters (except for vessels not engaged in commerce) and prohibit discharges affecting natural resources of, pertaining to, or under

[69] U.S. Congress, Office of Technology Assessment. *Coastal Effects of Offshore Energy Systems.* Washington, D.C., Government Printing Office, 1976, p. 76.

[70] U.S. Congress, Joint Committee on Atomic Energy. *Towards Project Interdependence: Energy in the Coming Decade.* 94th Cong., 1st sess. Washington, D.C., Government Printing Office, 1975, p. 35.

[71] U.S. Congress, House, Ad Hoc Select Committee on Outer Continental Shelf. *Effects of Offshore Oil and Natural Gas Development on the Coastal Zone.* 94th Cong., 2d sess. Washington, D.C., Government Printing Office, 1976, p. 7.

[72] National Academy of Sciences op. cit. note 63.

[73] U.S. Congress, op. cit. note 71, p. 135.

[74] *U.S. vs. Standard Oil Company,* 384 U.S. 224, 86 S. Ct. 1427, 16 L. Ed. 2d 492, (1966).

exclusive U.S. management authority. Although many aspects of the regulations relate only to tank ships and tank barges, these regulations also apply to merchant ships, fishing boats, and recreational boats. Standards for bilge and ballast piping, oil transfer hoses, qualifications for the person-in-charge of an oil transfer, and required tests and records are also set out in the regulations.

Section 311 of the Federal Water Pollution Control Act of 1972 prohibits the discharge of a harmful quantity of oil and hazardous substances in any form into or upon U.S. navigable waters, shorelines, of contiguous zone (now encompassing the entire riverine system within the United States upstream to the source), and seaward as may be included in the Clean Water Act of 1977. The person in charge of the vessel or an onshore or offshore facility must notify the Coast Guard National Response Center in the event of any discharge of a harmful quantity of oil or hazardous substances. The penalty against an owner or operator for discharging a harmful quantity of oil is a civil penalty of not more than $5,000 administered by the Coast Guard. The penalty for failure to report a discharge is a criminal penalty of not more than $10,000 and/or 1 year imprisonment.

The owner or operator is liable to the U.S. Government for removal costs of an oil discharge. An inland oil barge owner is limited in liability to the greater of $125,000 or $125 per gross ton of the barge and, in the case of any other vessel, $150 per gross ton, or for a vessel carrying oil or hazardous substances as cargo, $250,000 or $150 per gross ton, whichever is greater. Facilities are liable up to $50 million. Where the United States can show that the discharge was the result of willful negligence or willful misconduct within the privity and knowledge of the owner, then there is no limit to the liability for cleanup; the owner or operator must pay all the costs. No liability exists for discharges caused solely by acts of God or war, negligence on the part of the U.S. Government, an act or omission by a third party, or any combination of these causes. Violations of the pollution prevention regulations or any other regulations governing oil pollution issued pursuant to the Federal Water Pollution Control Act, as amended, carry a civil penalty of not more than $5,000.

A Pollution Information Response System was placed in operation in 1973. This provides spill analysts with complete pollutant discharge histories and data for analysis of spill occurrences. The system includes data relating to the time, specific location, source, primary cause, secondary cause, tertiary cause, material spilled, and volume of all polluting incidents. The weather and sea condition at the time of the spill and resources affected by the spill are described in detail for each polluting accident. Spill response, cleanup activities, and penalty actions are also described in detail for each polluting incident.

In 1976, the Coast Guard identified over 12,685 discharges. Of a possible $67,600,000 in civil penalties, $1,491,000 was assessed against illegal discharges. To reduce the number of "mystery" spills, the Coast Guard had developed a series of scientific techniques to "fingerprint" oil spills by chemical analysis in order to match them to their source. To respond to major or unusual discharges, the Coast Gaurd has developed the National Strike Force consisting of 55 highly trained personnel on the Atlantic, Gulf, and Pacific coasts to assist the spill cleanup "On-Scene Coordinator." In addition to domestic pollution emergencies, the Strike Force has assisted foreign governments (upon diplomatic request) in several pollution incidents.

The Ports and Waterways Safety Act of 1972 gives the Coast Gaurd the statutory authority to deal with the increasing safety hazards of maritime transportation and with pollution resulting from the operation of, and casualties to, vessels carrying oil or hazardous substances. The Coast Guard has promulgated regulations that apply to the design, equipment, and operation of U.S. tank vessels. Additionally, regulations have been published that extend those rules to U.S. tank vessels carrying oil in foreign trade and foreign tank vessels entering the navigable waters of the United States.

Title I of the Ports and Waterways Safety Act of 1972 authorizes the Coast Guard to implement Vessel Traffic Services (VTS), which include strengthening navigation regulations, establishing limited navigation areas, and providing basic traffic separation schemes for both ocean and coast. Vessel Traffic Services have been established in five major port areas using advanced systems of surveillance and communications to regulate navigation. The effectiveness of VTS is manifest in the improved safety record of the ports operating with traffic separation schemes.[75]

Oil Spill Liability and Compensation

In recent years, with increasing public concern over marine oil pollution, Federal and State governments began enacting laws pertaining to liability for vessels and handling facilities. In each instance, they have attempted to clarify and expand liability standards, impose preventive requirements, and ensure some type of compensation.

[75] U.S. Congress, Senate, Committee on Commerce. *Ports and Waterways Safety*. 94th Cong., 2d sess. Washington, D.C., Government Printing Office 1976, p. 60.

The Federal Water Pollution Control Act of 1970, as amended (33 U.S.C. 1321), was the first to provide specifically for recovery from damages resulting from unintentional spills. The owner or operator is liable for the costs of spill cleanup and removal operations involving navigable waters or contiguous zone waters unless the spill results from an act of God, war, U.S. Government negligence, or an act of omission of a third party. The Act established liability limits. It also established a $35 million contingency fund to cover spill cleanup by governments (Federal, State, and local) in cases where the source of the spill cannot be ascertained or where cleanup is not being made by the responsible party.

The Trans-Alaska Pipeline Act (43 U.S.C. 1653) and the Deepwater Port Act of 1974 (33 U.S.C. 1502 et seq.) both impose liability for all discharges by the vessels and facilities covered in the Acts. Both Acts establish liability funds that may vary with the source of the spill and whether or not it resulted from negligence or willful misconduct.

The OCS Lands Act of 1953 (43 U.S.C. 1331 et seq.) also covers oil pollution liability. It does not specifically establish liability for damages, but does authorize the Secretary of the Interior to promulgate regulations for items referred to in the Act, including conservation and protection of natural resources. Current regulations hold the lessees liable to the Federal Government for cleanup and removal costs resulting from spills relating to exploration and development activities.

The Federal statutes, though pertaining to different sources of oil, are still somewhat overlapping, i.e., vessels covered by the Alaska Pipeline Act and the Deepwater Port Act could also fall within the scope of the Water Pollution Control Act, for instance. Differences in standards and liability limits among the Acts could then result in controversies.[76]

A further complication arises with regard to the relationship between State and Federal laws. States' efforts have ranged from codifying the remedies in common law to legislatively imposing strict liability. Some State statutes list defenses for relieving strict liability with proof of acts of war or God, third party negligence, intentional acts, and State or Federal Government negligence. Other State statutes establish the no-fault liability. Sources of oil pollution covered, liability limits, financing of funds, etc., vary among States. All of these factors contribute to the difficulty of resolving the issue of liability and compensation.

Today, in response to the need for resolution of this issue, various bills have been introduced in both the House and the Senate which provide for a comprehensive system of liability and compensation for oil pollution.

There are three "Superfund" bills now before the Senate (S. 1187, S. 2083, and H.R. 6803). These bills provide for liability for several different types of damages, recognize claims from nongovernment entities, and provide for a more comprehensive and effective system of compensation. H.R. 6803, which has passed the House (September 12, 1977), is closely alined with the Administration bill, S. 1187; the major difference being that it lacks the provision for fund payment of the cost of oil spill damage assessment. It establishes a $200 million revolving Treasury fund for payment of liability resulting from oil pollution damage. Claims may be made for:

- removal,
- loss or injury to or destruction of real or personal property,
- loss of use of natural resources,
- loss of profits or impairment of earning capacity due to injury or destruction of real or personal property or natural resources, and
- loss of tax revenue for 1 year resulting from injury to real or personal property.

The President is the trustee for U.S. natural resources. The fund is to be coadministered by the Department of Treasury and the Department of Transportation. Liability limits are established for different class vessels and facilities and require the owner or operator to prove financial responsibility.

S. 2083 was developed by the Senate Commerce Committee. It differs in its specific approach to several issues regarding the liability and compensation proposals, and it directs the Secretary of Commerce and the Secretary of the Treasury to jointly administer the fund.

In summary, the bills create a system of strict liability of damage and cleanup costs, set liability limits for owners and operators, and establish a compensation fund for damages above owner/operator liability limits. They also preempt State laws, thereby establishing one uniform compensation program. Authority rests with the Secretary of Transportation. If such legislation passes, it would supercede the liability and compensation provisions of other legislation, including the proposed OCS Lands Act Amendments, which provide procedures for compensation for cleanup costs and damages occurring as a result of OCS activities.

[76] U.S. Congress, Senate, Committee on Commerce and the National Ocean Policy Study. *Methods and Procedures for Implementing a Uniform Law Providing Liability for Cleanup and Damages Caused by Oil Spills from Ocean Related Sources: A Study by the Department of Justice.* 94th Congress, 1st sess. Washington, D.C., Government Printing Office, 1975.

Legislative Authorities

In 1953, in response to the increasing agitation among coastal States, the Congress enacted two pieces of legislation establishing jurisdiction over offshore resources. These were:

- The OCS Lands Act of 1953. The U.S. Department of the Interior was designated by this legislation as the responsible agency for the majority of the Act's provisions regarding mineral leasing and development of offshore resources beyond States' jurisdictions. The Bureau of Land Management and the U.S. Geological Survey have been assigned responsibility for resource development, safety, resource evaluation, and environmental protection. Other Federal agencies have responsibilities under the Act. The U.S. Coast Guard is responsible for enforcing regulations on warning devices, safety equipment, and safety of life and property. U.S. Army Corps of Engineers issues one of the permits required for construction (including pipelines) on the OCS and in other navigable waters. The Corps' jurisdiction was extended to artificial islands and fixed structures on the OCS.
- The Submerged Lands Act of 1953. This Act granted coastal States responsibility over submerged lands seaward to 3 miles. A greater area was granted Florida and Texas. It reaffirmed Federal jurisdiction beyond the State seaward boundaries.

Additional Federal responsibilities and authorities related to OCS oil and gas activities are vested in a number of agencies:

- Environmental Protection Agency (EPA). Is responsible for pollution control and waste disposal.
- Federal Power Commission (now FERC). Grants certificates for public convenience and necessity and determines amounts of OCS gas purchased and transported;
- Interstate Commerce Commision. Grants approval of tariff rates for common carrier pipeline oil transport;
- Department of Transportation, Materials Transportation Bureau. Establishes standards for pipeline construction, operation, and maintenance; and
- Department of Commerce, NOAA. Protects marine fisheries resources through consultation with the Corps in its issuance of permits in navigable water.

Evolution of the Offshore Leasing Program

In the early years of the program, OCS leasing aroused concern only in some local areas of the Gulf of Mexico and the program was subject to little national scrutiny. This changed with the major blowout in the Santa Barbara Channel in 1969. As a result of this oil spill, the OCS leasing program moved into the national limelight and as a result of the 1973 energy situation has remained there ever since. Lawsuits against the Federal Government became more frequent, as the Arab oil embargo brought the OCS to previously undeveloped areas.

In December 1974, suit was brought against the Interior Department in an attempt to forestall a proposed lease sale off Alabama, Florida, and Mississippi. The plaintiffs maintained among other things that there was insufficient environmental information. The court, however, ruled that an adequate assessment based on available information had been made. Even so, as a result of this case the Department of the Interior made a commitment to begin environmental studies in the area, and out of this has grown the present Bureau of Land Management studies program.

In January 1974, the President announced that 10 million acres were to be leased in 1975—equivalent to the amount leased since 1953. The decision to accelerate leasing in combination with Interior's previous history of little or no substantive consultation and coordination with affected coastal States brought increased pressure on the agency.[77] The Department of the Interior took steps toward involving components outside the Federal Government in the following ways:

- Requests for comments on the 17 potential OCS leasing areas.
- Establishment of the OCS Research Management Advisory Board (now the OCS Environmental Studies Advisory Committee).[78] This Committee is composed of both Federal and State representatives.
- Issuance of the draft and final programmatic EIS for the accelerated program.
- Participation of States in the tract selection process, including attendance at BLM–GS briefings and deliberations. This participation was initiated in 1975.
- Participation by States in developing lease stipulations involving special environmental protection requirements and other mitigating measures.

[77] U.S. Congress, Committee on Commerce. *Outer Continental Shelf Oil and Gas Leasing Off Southern California: Analysis of Issues.* Committee Print. S. Res. 222 National Ocean Policy Study. 93rd Congress. 2d Sess. 1974, 100 pp.

[78] As of December 1977, it was reorganized to be the National OCS Scientific Advisory Council, separate from the OCS Advisory Board (policy).

- Commitment by the Secretary to the preparation of environmental statements on development plans in frontier areas.
- Establishment by the Bureau of Land Management of the Intergovernmental Planning Program for Leasing and Transportation of OCS Oil and Gas. This program, in addition to formalizing existing pre-leasing coordination, sets up a Federal-State-industry partnership for planning for transportation of oil and gas from the OCS to shore.
- Endorsement by the Secretary of proposed amendments to the OCS Lands Act, designed to increase State and public participation in the leasing decisionmaking process, to alter the bidding system, and otherwise improve the management of the program. Administrative procedures to implement many of the proposed changes have already been put into effect.

Following the decision to accelerate leasing numerous bills that would amend the OCS Lands Act were introduced in the 94th Congress. None were enacted.

Largely because of strong State objections and DOI's efforts to provide more meaningful public and State involvement, the OCS leasing timetable has been slowed down since 1975. In May 1977, Interior announced a revised leasing schedule for sales through 1978. The 1977–78 leasing plan included sales in the less sensitive areas and did not include areas in Alaska, California, and the South Atlantic. In late summer 1977, Interior published its new 5-year leasing schedule.

Several factors in the past have contributed to the conflicts surrounding the OCS program. Among the most significant are:

- The Santa Barbara oil spill,
- Growing knowledge of the importance of OCS oil to offset our dependence on foreign supplies,
- President Nixon's accelerated leasing decision and Interior's attempts to implement it,
- Increasing public concern over the impacts of expanded OCS production,
- Increasing State and local government concern over their past lack of participation in leasing decisions,
- Growing awareness of the potential for oil in the frontier areas, and
- Increasing use of OCS oil as a short-term solution to the Nation's energy problem.

OCS Environmental Studies

Since the OCS studies program began, the Bureau of Land Management (BLM) has contracted for over $125 million in baseline and special marine studies. In 1974, BLM and NOAA entered into an arrangement for BLM funding of work performed by NOAA for the Alaska OCS Environmental Assessment Program.

The Bureau's OCS studies program has been controversial almost since its beginning. One criticism has been that the information from the studies has not been effectively tied to leasing decisions. Critics charge that the purpose of the studies has not been defined fully, and that there has been no program development plan for the complete program and no overall policy statement. According to the Office of Technology Assessment, the nature of the relationship between the studies and the leasing decision process is the primary issue. These and other concerns have been voiced by both the OCS Advisory Board and the OCS Environmental Studies Advisory Committee.

In the past 2 years, dissatisfaction with the program has increased, even within the Department of the Interior itself.[79] During the June 1977 meeting of the OCS Advisory Board, Guy Martin, Assistant Secretary for Land and Water Resources, stated that there was a need to reexamine the OCS environmental studies program to determine if the proper type of information existed for the different decision points in the leasing program. He further suggested that the Advisory Board determine the policy for the OCS Environmental Studies Advisory Committee to implement.[80]

Recent indications from the Assistant Secretary's office reflect the view that the baseline program has been misdirected and that the information collected has not been as useful as it could be to the leasing decision-maker. The suggestion is that specially designed mission-oriented studies would be of more value.

At the request of BLM, the National Academy of Sciences made a detailed assessment of the overall OCS environmental studies program. The conclusion was that the program had not been based on research appropriate to answer environmental concerns for offshore oil and gas leasing and that the program "does not now effectively contribute to leasing decisions or to the accrual of sound scientific information adequate for OCS management, both offshore and onshore."[81] Recommendations were made concerning program design, implementation, and utility. It should be noted that there are those in the scientific community who feel that the importance of long-term baseline measurements of living resources should not be minimized and that these, coupled with process-oriented studies, should provide the principal thrust of the BLM–OCS studies.

The following activities have been undertaken recently by the Interior Department in an attempt to alleviate some past public concerns:

[79] U.S. Department of the Interior. Record, Meeting of the OCS Environmental Studies Advisory Committee. July 19, 1977.
[80] Ibid.
[81] National Academy of Sciences—National Research Council. *OCS Oil and Gas: An Assessment of the Department of the Interior Environmental Studies Program.* A report to the Department of the Interior, 1977, p. 107.

- The Bureau of Land Management has proposed a planning program for the acquisition and evaluation of management information and for coordinated intergovernmental management planning regarding leasing and transportation of OCS oil and gas. The proposal would establish Regional Working Groups in each leasing area composed of representatives from the affected States, BLM, NOAA, Fish and Wildlife Service, Geological Survey, the U.S. Coast Guard, industry, and other interests as appropriate.
- In July 1977, BLM published proposed regulations for OCS Leasing Environmental Studies.[82] These regulations formalize the current program which began in 1972. The regulations govern the timing and nature of the BLM studies as needed for assessment and management of impacts on marine and coastal environments of the OCS resulting from oil and gas leasing. NOAA will be used to the extent practicable.
- On October 4, 1977, U.S. Geological Survey regulations were established for OCS oil and gas operations—suspension procedures. The regulations detail the procedures for suspension of operations due to threat of significant irreparable damage to life, property, or natural resources.
- On the same day, October 4, 1977, BLM proposed regulations for OCS oil and gas lease–suspension and the 5-year term, were also completed. The proposed rule clarifies the way in which the term of an OCS oil and gas lease runs when it is subject to a suspension. The purpose of this rule-making was for consistency with the Geological Survey suspension regulations.
- In September 1977, the U.S. Geological Survey published in the Federal Register proposed regulations for the Outer Continental Shelf Oil and Gas Information Program.[83] The proposed regulations describe policies, procedures, and requirements for specifying relevant oil and gas data and information resulting from OCS activities that may be made available to affected States and local governments.
- On the same date, the Bureau of Land Management published its proposed rules for an OCS leasing oil and gas information program.[84] These rules also deal with the release of information to the States for their use in determining impacts and planning accordingly.
- In the same month, Geological Survey published proposed regulations for oil and gas and sulphur operations on the Outer Continental Shelf (a revision of existing operating regulations for exploration, development, and production on the OCS).[85] The proposed regulations provide policies, procedures, and requirements for affording States timely access to information related to onshore and offshore activities. They also prescribe mechanisms for review and comments on OCS decisions. They deal in specific terms with exploration and development plans and environmental reports to be submitted by the lessee. The regulations provide items to be assessed for determining whether or not an environmental impact statement is required for a development and production plan. They further list criteria for determining when a general area statement will be required.

Deep Seabed Mining

Introduction

The deep seabed areas of the oceans, beyond the continental margins, contain mineral deposits known as manganese nodules. These mineral resources, some of which are found in water depths greater than 15,000 feet, contain cobalt, copper, manganese, nickel, and other metals. Commercial interest in manganese nodules has been increasing since the 1960s in the United States, as well as in a number of other industrialized countries. Millions of research and development dollars have been committed by private industry to the discovery of prime-quality deposits, the design and testing of mining recovery systems, and the development of metallurgical processing techniques for extracting the key metal components from the nodule ores. The technological leaders in this new industry have established commercial operating plans requiring several years of additional detailed exploration and prototype equipment testing leading toward full-scale production.

Today, ocean mining stands on the threshold of becoming a reality. But the continuing absence of a stable legal and political framework in which these activities may occur results in serious questions as to whether this transformation will take place in a timely manner or be indefinitely delayed. The uncertainty arises from the location of proposed ocean mining operations—beyond the national jurisdiction of any country. While the international community has been attempting for many years to create a new legal framework for minerals exploitation in the deep seabed, no agreement has yet been reached. Recent developments have increased the uncertainty that the negotiations can be successfully concluded.

[82] *Federal Register*, Vol. 42, No. 133, Tuesday, July 12, 1977.

[83] *Federal Register*, Vol. 42, No. 186, Monday, September 26, 1977.

[84] Ibid.

[85] *Federal Register*, Vol. 42, No. 187, Tuesday, September 27, 1977.

The United States, therefore, has recognized the need for interim domestic legislation so that ocean mining may proceed.

The recovery of nodules from the deep seabed presents a unique natural resource problem. The conservation principles of protecting the environment and providing for the orderly development of the resource must be met. In addition, there is another principle of recognizing the international nature of these resources and creating a mining environment consistent with international obligations. This principle adds a unique complexity to this natural resource problem and makes achievement of the other principles more difficult.

Nature and Extent of the Resource

The origin of the deep-sea deposits of hydrous ferromanganese oxides or manganese nodules has been under debate for some time. Several theories have been cited, including introduction of manganese from land drainage and subsequent precipitation on the seafloor, introduction from submarine volcanism with subsequent precipitation in an oxidizing environment, and dissolution from hemipelagic sediments under reducing conditions and reprecipitation near the oxidizing sediment/water interfaces.[86] It is likely that any one of these mechanisms may dominate, depending on the local environment. A somewhat more controversial theory is that nodule growth and dissolution is controlled by bacterial action. Both theoretical and experimental evidence for this have been presented.[87]

The nodules are widespread, but unevenly distributed. In some large areas they may cover 100 percent of the seafloor and in other areas be entirely absent. The reported range of concentration varies widely, growth rates also vary, and nodule size may not be a direct function of age. Mineral content apparently correlates with other nodule parameters and environmental factors. For example, depth correlates directly with cobalt and copper content in the Pacific.[88]

Data available on worldwide distribution of manganese nodules and other subsea resources were consolidated into a set of maps and published by the U.S. Geological Survey in 1970 as map I–632. Subsequently, considerable work has been done in the northeast equatorial Pacific Ocean under the manganese nodule project of the National Science Foundation and under various academic investigations under Sea Grant programs. Scripps & Lamont Doherty laboratories have already participated in this research. Detailed prospecting and exploration have been made by industrial concerns, both U.S. and foreign, but this information is generally not in the public domain.

From a resource standpoint, the depth zones between 3,000 and 6,000 meters have the most potential. Estimates of resources for the Pacific Ocean have been reported by Mero (1965)[89] at 1,700 billion metric tons, later revised (1967) to 1,500 billion, and by Zenkevitch and Skornyakova (1961)[90] at 90 billion metric tons. Mero's figures are based on measurement from 101 photographs and cores and grab samples; most of the calculations concerning manganese nodule tonnages are admittedly speculative and have little meaning in an economic sense. More data are available now, and compilations of resources have been published by others. These reports suggest that the extent of nodules in the Pacific Ocean is about 1,500 billion metric tons.

Less is known about nodules in other oceans. For the purpose of world resource estimates, a total of 1,700 billion metric tons, as reported by Mero (1965)[91] and cited by MeKelvey et al. (1969)[92] may be assumed. This estimate includes 1,500 billion metric tons in the Pacific, 150 billion metric tons in the Indian Ocean, and 50 billion metric tons in the Atlantic. Estimates for the Arctic or small ocean basins have not been made.

Data available on the worldwide distribution of potential mine sites were summarized in a 1976 staff study by the Department of Interior's Ocean Mining Administration.[93] The richest concentrations apparently are in the Pacific north of the Equator, extending from the Hawaiian Islands to the west coast of Mexico, a region about 2,600 miles long and 500 miles wide.

The Bureau of Mines is developing a comprehensive computerized data base on nodule location, analyses, and sample information; data have been entered for more than 5,000 samples from more than 2,700 stations in the Pacific and Indian Oceans. The information is compiled under contracts and grants with universities and other oceanographic institutions, including company data where available. These data are being incorporated into a series of mineral resource and bathymetric maps to be published. Based on these data, nodule units are being identified

[86] E. Bonatti, "Authigenesis of Minerals—Marine," in *Encyclopedia of Geochemical and Environmental Sciences*, S. V. Hill (ed.). Volume IV A, 1972, pp. 45–56.

[87] H. L. Ehrlich, The Microbiology of Manganese Nodules. Final Technical Report, Task No. NR 137–655, Office of Naval Research, U.S. Department of Defense, 1970, pp. 1–17.

[88] A. M. Ehrlich. Rare Earth Abundances in Manganese Nodules. Ph.D. Thesis: Massachusetts Institute of Technology, 1968, pp. 3–216.

[89] J. L. Mero. *The Mineral Resources of the Sea.* New York: Elsevier Publishing Company, 1965, p. 312.

[90] N. Zenkevitch and N. S. Skornyakova. "Iron and Manganese on the Ocean Bottom" *Natura* (U.S.S.R.), 1961, p. 47–50.

[91] J. L. Mero, op. cit. note 89.

[92] U.S. Department of the Interior, Geological Survey, Subsea Mineral Resources and Problems Related to Their Development, by V. E. McKelvey, J. I. Tracy, G. E. Stoertz, and J. G. Vedder, *USGS Circular* 619. Washington, D.C., Government Printing Office, 1969.

[93] U.S. Department of the Interior, Ocean Mining Administration. *Manganese Nodule Resources and Mine Site Availability*, by A. Holser, Professional Staff Study, August 1976.

in specific localities for tonnage, grade, and operational costs.

In support of the NOAA DOMES Program, the U.S. Geological Survey is continuing basic scientific studies on details of nodule characteristics, sediments, sedimentary water, plume dispersions, and settling rates and associated geologic investigations.

State of Technological Development

The state of technology in the developing deep-seabed mining industry is quite well advanced. Prospecting and exploration activities have been carried out by a number of companies since the early 1960s. The basic methods of exploration have advanced from random tracking and sampling with wire line buckets and drop corers or grabs to well designed exploration using precision depth recorders, deep towed instrument platforms with subbottom profilers, side scan sonar, T.V., stereo-color photography, and free fall boomerang box corers and grabs. Real-time data reduction using computers is becoming standard procedure. Bulk sampling for metallurgical purposes has continued to rely on primitive, but adequate, bucket dredges. Major gaps in exploration technology are found in the very slow rate of exploration coverage (2 to 3 knots with towed platforms) and in the testing of large areas of engineering properties, a slow and unreliable process with results that are difficult to confirm. Navigational and positioning capabilities are fully in line with the accuracies needed for exploration and, probably, for commercial production needs.

The mining process involves gathering the nodules from the seabed in depths up to 6,000 meters and lifting them to a surface platform. Two basic methods for collection and lift have been tested at sea. One is a continuous bucket line which involves an endless rope looped to surface platforms and rotating slowly so that buckets attached to the line will drag across the bottom at predetermined intervals as the platforms move across the nodule field. All the mechanical problems for this system, which involves some 9 kilometers of line and hundreds of buckets, have yet to be resolved fully, and it may take several years to perfect the system. Unverified cost advantages are claimed for the bucket line over the hydraulic system, which has also undergone at-sea tests using a gathering device which is towed at the end of the hydraulic pipe. Pump suction or air lift methods have both been tested, but not at full scale. Four major consortia now plan tests under actual mining conditions, though at less than production capacity. One of these will introduce a controlled gathering device which will traverse the bottom under its own power instead of under tow by the surface platform. The testing and evaluation of these systems may take 2 to 3 years. At that time, investment decisions for full-scale commercial production systems would be made.

Major shortcomings in the technology of deep-seabed mining can only be resolved by actual operation. They include the ability to match the seabed equipment to the physical characteristics of the seabed and the ability to forecast environmental disturbances caused by the operations. It is likely that any major technical problems would involve equipment reliability under the stress of continuous operation. Transportation and unloading requirements should present few technological surprises, and standard procedures can be adapted to these tasks.

The technology of processing the ore to extract the metals has been well developed. Public statements by U.S.-connected companies and development work by the U.S. Bureau of Mines indicate that there are several potentially economic options in this regard. Unquestionably, improvements in processing technology will be sought as full-scale plants come on stream, but it does not seem at this time that there are any major technological deficiencies to be overcome.

In summary, the technological development of ocean mining systems is well advanced for first generation systems, although the reliability of materials and design has yet to be tested under continuous operational stress. The next 2 to 3 years should be significant in the confirmation or rejection of the present, partially developed, concepts.

Potential and Importance to the United States

Importance of the Minerals

The four metals of principal interest contained in manganese nodules are copper, cobalt, manganese, and nickel. Of these four metals, the United States imports about 98 to 99 percent of annual cobalt and manganese consumption, over 70 percent of nickel consumption in an average year, and 25 percent or less of annual copper production. Table 6–1 compares annual consumption, mine output, reserves,

Table 6–1.—Statistics for value metals obtainable from manganese nodules[1]

In thousands of short tons.

	Annual consumption (primary and secondary)	Annual mine output	Reserves	Reserves as years of consumption
Copper	2,350.0	1,610	93,000	39.6
Cobalt	10.3	0	0	0
Manganese	1,307.0	0	0	0
Nickel	227.6	17	200	0.9

[1] U.S. Department of the Interior, Bureau of Mines. *Commodity Data Summaries—1977.* pp. 42, 46–7, 98, 112–13.

nd reserves indicated in years of consumption for 1976.

Although these data oversimplify the U.S. position in the short term, as stockpiles, increased recycling, or demand reductions are not considered, the long-term position is more clear. The United States has little, if any, potential for significant production of cobalt or manganese. U.S. copper reserves are large, and the United States is the largest copper producer in the world. However, imports as a percentage of consumption have increased over recent years. Domestic nickel production is not significant, and is unlikely to become so until technological advances make deposits economic.[94]

The four metals most likely to be recovered from nodules are important to the U.S. economy. About two-thirds of nickel consumption goes into the manufacture of capital goods. Consumer durables are the largest end use of the remaining one-third, with automobiles being the largest single element. Nickel is often used as the principal alloying ingredient in high-performance steels. An example is jet engine turbine blades.[95]

Manganese is also an important ingredient in steelmaking. There is no acceptable substitute for manganese as a toughening agent and as a sulphur-removing or fixing agent.[96] About 95 percent of world manganese output is used in steel production.

Cobalt metal is used principally in alloys, permanent magnets, and cemented carbides. Superalloys containing from 36 to 65 percent cobalt can withstand severe stress at temperatures up to 1,600 degrees F. Although for some uses, cobalt and nickel are nearly interchangeable, and other alloying metals are substitutes in other uses, cobalt is clearly superior for many specialized uses such as carbides and some tool steels.[97]

Over one-half of copper consumption is for electrical uses. In 1976, copper consumption was estimated by use as: electrical, 58 percent; construction, 14 percent; transportation, 9 percent; ordnance, 2 percent; and miscellaneous, 5 percent.[98] Although many other metals and materials may be substituted for copper in specific uses, such as aluminum for electrical purposes, or plastic for plumbing, copper often provides superior performance.

Of the four principal metals of interest in manganese nodules, the United States is not likely to be a producer of manganese and cobalt and not likely to have significantly increased production of nickel in the foreseeable future. Our copper reserves are large, but imports constitute an important share of consumption.

The interest in developing a new source for these metals is not because of threats of shortages, cartel actions, or embargoes. Rather, the interest is in diversifying the sources of these important metals so that the United States will not depend on only one or a few sources for any of them.

Economic Potential of the Resource

Manganese nodules are a marginal resource now. The best estimates of cost and return on investment publicly available [99] indicate that, with current technology, deep sea deposits can compete with land-based mineral deposits in the foreseeable future.

A manganese nodule mine will produce at least three metals: cobalt, copper, and nickel. As mining and processing techniques become perfected and their costs are better estimated, some potential producers are indicating that manganese will be produced to assure profitability. Given that all four metals may be produced, the potential importance of nodules as a source of metals is shown in table 6–2 for various levels of production. One deep-sea mining operation is likely to process about 3 million short tons of dry nodules per year.

Clearly, an ocean mining industry will not be able to operate profitably unless it can produce manganese, nickel, and cobalt at prices low enough to capture a large share of future growth. As low-cost nickel deposits are exhausted and production becomes concentrated in higher cost lateritic deposits, deep-sea output can gain a place in the market. Inasmuch as lateritic deposits are energy intensive, steadily rising energy prices will improve the competitive position of deep-sea deposits. However, if several operations produce simultaneously, it is possible that world prices of manganese, nickel, and cobalt may be reduced.

With neither operating history nor firm cost estimates, the economic importance of manganese nodules is necessarily speculative. Recent reports [100,101] do indicate that investments in ocean mining are likely to be at least as attractive as investments in lateritic nickel deposits in the short term with higher risks offset by a higher potential rate of return. The long-term outlook is even more optimistic as long as world prices hold at predicated levels.

[94] U.S. Department of the Interior, Bureau of Mines. *Mineral Facts and Problems*, 1975 Edition. Washington, D.C., Government Printing Office, 1976, p. 747.

[95] Arthur D. Little, Inc. "Technological and Economic Assessment of Manganese Nodule Mining and Processing," contract report for U.S. Department of the Interior, Office of Minerals Policy and Research Analysis, Cambridge, Mass., November 1977, pp. 62–64.

[96] Ibid., pp. 74–76.

[97] U.S. Department of the Interior, op. cit. note 94, p. 276.

[98] U.S. Department of the Interior, Bureau of Mines. *Commodity Data Summaries—1977*, pp. 46–47.

[99] Arthur D. Little, Inc., op. cit. note 95.

[100] Arthur D. Little, Inc., op. cit. note 95.

[101] U.S. Department of the Interior, Ocean Mining Administration. *Ocean Mining—An Economic Evaluation*, by Rebecca L. Wright, Professional Staff Study, March 1976.

Table 6–2.—Potential importance of manganese nodules as a source of metals [1]

		United States				Free World			
		Nickel	Copper	Manganese	Cobalt	Nickel	Copper	Manganese	Cobalt
1975 consumption in thousand short tons [2]		145	1,540	1,130	6.4	470	6,000	6,000	20
Production from nodules as a percentage of 1975 consumption [3] for:									
Million short tons of dry nodules per year	2	20	1.6	38	59	6.1	0.4	7.2	19
	4	40	3.3	77	118	12.0	0.8	14.0	38
	6	60	4.9	115	177	18.0	1.3	22.0	58
	8	79	6.5	154	236	25.0	1.7	29.0	76

[1] U.S. Department of the Interior, Ocean Mining Administration. *Ocean Mining—An Economic Evaluation*, by Rebecca L. Wright, Professional Staff Study, March 1976.
[2] Commodity Data Summaries, U.S. Bureau of Mines; Metallgesellschaft AG; and ADL estimates.
[3] 90 percent recovery of metals; grades: Ni = 1.6%, Cu =1.4%, Mn = 24%, Co = 0.21%.

United Nations Law of the Sea Conference

The manganese nodules on the deep seabed lie outside the jurisdiction of any country and are considered the "common heritage of mankind." For this reason, they have been the object of extensive negotiations under the auspices of the Third United Nations Law of the Sea Conference. To date the Conference has been unable to reach agreement on who has the right to mine the nodules and what international controls should be placed on those miners.

The uncertainty of international legal and political developments bears directly on investments in ocean mining. Private companies are unwilling to advance ocean mining operations until the legal situation is clarified. It is generally recognized that a long-term, stable climate for investment can best be accomplished through an international regulatory regime under a new law of the sea treaty.

In 1975, after two substantive sessions of the Third United Nations Conference on Law of the Sea, a single negotiating text was drafted as the basis for future negotiations. This text was unacceptable to the United States because it contained no assurance that U.S. interests in maintaining access to these resources would be protected. A revised text developed in spring 1976 contained a number of improvements from the U.S. point of view. A two-part parallel system of development of deep seabed resources was devised. The first provided for mining by States and their nationals, which would be authorized through contracts with the International Seabed Authority under reasonable terms and conditions; the second provided for developments directly by the Authority through its operational arm, the Enterprise. This revised text attempted to balance and separate the powers and functions of the plenary organ, the Assembly, and the executive organ, the Council of the Authority. The major issues left unresolved were the composition and voting mechanism of the Council of the Authority and the statutes of the Enterprise and the Seabed Tribunal.[102]

At a later session in 1976, the developing countries insisted on returning to basic issues and nothing more was resolved. In the 1977 session, a new negotiating text was introduced that was described by the U.S. Ambassador to the Conference, Elliot Richardson, as "fundamentally unacceptable to the United States." [103] In his testimony to the Senate in October 1977, Ambassador Richardson enumerated the problems of the latest deep seabed text: [104]

- It does not give the reasonable assurance of access that is necessary if the United States and others are expected to help finance the Enterprise and to accept a "parallel system" as a basis of compromise.
- It could be read to make technology transfer by contractors a condition of access to the deep seabed, subject, at least in part, to negotiation in the pursuit of a contract.
- It could be read to give the Seabed Authority the power to effectively mandate the Authority as a condition for access.
- It fails to set clear and reasonable limits on the financial responsibility of contractors, possibly creating an obstacle to seabed development.
- It sets an artificial limit on seabed production of minerals from nodules, which is not only objec-

[102] U.S. Department of the Interior. *Mining and Minerals Policy—1977 Annual Report under the Mining and Minerals Policy Act of 1970*. Washington, D.C., Government Printing Office, 1977, pp. 135–6.
[103] E. Richardson, Ambassador to the U.N. Law of the Sea Conference, Testimony before the Senate Committees on Commerce and Energy and Natural Resources, October 4, 1977.
[104] Ibid.

tionable in principle, but also far more stringent than necessary to protect land-based producers from possible adverse effects.

- It gives the Seabed Authority extremely broad, open-ended power to regulate all other mineral production from the seabed "as appropriate."
- It could be read as giving the Authority unacceptable new power to regulate scientific research in the area.
- It fails to adequately protect minority interests and would, accordingly, allow the abuse of power by an anomalous "majority."
- It allows the distribution of benefits from seabed exploitation to peoples and countries not parties to the Convention.
- It seriously prejudices the long-term character of the international regime by requiring that, if agreement to the contrary is not reached within 25 years, the regime automatically be converted into a "unitary" system, ruling out direct access by contractors, except to the extent that the Authority might seek their participation in joint ventures with it.

For a system that would manage half of the Earth's surface, these are serious deficiencies. They would unnecessarily inhibit, and perhaps even prevent, deep seabed development. The next session of the Law of the Sea Conference is scheduled for spring 1978. Ambassador Richardson feels that the next session will reveal finally whether a comprehensive treaty is possible in the near future.

The Federal Role and Congressional Initiatives

While the United States continues to pursue a satisfactory international resolution in the Law of the Sea Conference, the Administration also supports the enactment of interim legislation that would authorize U.S. seabed miners to move forward. U.S. legislation establishing a domestic regime for seabed mining will be needed, whether there is an international treaty or not, to regulate U.S. seabed mining in accordance with sound conservation principles. Additionally, in the absence of a treaty, the United States will need assurance that existing international rights in the areas beyond national jurisdiction are protected.

If there is to be any meaning to the concept of a "common heritage of mankind," those with the technology and resources to make seabed mining a reality must be allowed to move forward. In the Administration's view, legislation should meet the following criteria: [105]

- Be interim in nature, providing for its own succession by a treaty;
- Contain provisions for harmonizing U.S. regulations with those of reciprocating states so as to avoid conflict;
- Provide for resource conservation, including environmental protection;
- Provide that seabed mining by U.S. companies produce financial benefits for the international community.
- Not require that processing plants be located in the United States;
- Not offer U.S. mining companies financial protection against adverse effects of a treaty concluded subsequent to the passage of legislation and expenditures by those companies; and
- Assure that all provisions of the legislation leave undisturbed the concept of freedom of the high seas.

In 1977, the Congress considered several bills that would establish a domestic authority for deep seabed mining. Two of these bills, H.R. 3350 and S. 2053, are likely to be considered further in 1978. The Administration is proposing amendments to H.R. 3350 which, if adopted, would bring the bill into alinement with the criteria listed above.

Under the terms of the proposed deep seabed mining acts, the United States would issue licenses for exploration and permits for mining manganese nodules on the deep seabed. The acts would provide for development of deep seabed mining technology and regulation of operations of U.S. citizens consistent with sound resource conservation principles. These operations would be conducted in accordance with the doctrine of Freedom of the High Seas. Licenses and permits would be issued to qualified U.S. citizens under regulations to be promulgated by an administering agency. All provisions of the National Environmental Policy Act of 1969 would be adhered to in the licensing and permitting operation.

Licensed operators and permit holders would be required to follow resource conservation regulations, including environmental controls, established by the administering agency after suitable public hearings. These operations would be subject to continuing inspections and monitoring.

Environmental Aspects of Seabed Mining

Today, the broader major potential problems center around the following:

- The Law of the Sea (LOS) negotiations and industry and the U.S. Government concerns;
- U.S. seabed mining legislation vs. Law of the Sea negotiations;
- The lack of information on environmental effects in areas with new technology; and
- Environmental regulation in an international arena.

This discussion will focus on those problems specifically involving environmental concerns.

[105] Op. cit. note 103.

Environmental Regulation in an International Arena

The United States will not be alone in deepsea development; therefore, our domestic controls will not ensure environmental protection. Other nations' environmental values are often not as advanced as our own. This is no new problem, and history illustrates the problems for environmental regulation in this type of situation; e.g., the International Whaling Commission, the Intergovernmental Maritime Consultative Organization (IMCO), and so on. The list of factors signalling problems for environmental regulation is lengthy indeed.

Until the international community demonstrates an intention for strict environmental regulation, one procedure for the United States is through our own legislation, thereby extending the reach of our control in the environmental area. As previously mentioned, U.S. national controls would not ensure environmental protection, but they could be effective. Proper U.S. controls could result in tighter environmental standards for U.S. industry techniques and technology. Established, successful U.S. standards could possibly strengthen our position in international negotiations for environmental regulations.[106,107]

In international negotiations, the United States should place emphasis on the right of participating countries to establish their own standards; higher, if desirable, than those of the Authority.

A closely related question and one of concern deals with enforcement authority for international standards. Traditionally, international agencies have not been vested with enforcement powers. Mechanisms and procedures should be clearly spelled out.

Lack of Environmental Effects Information

Deep-sea mining has loomed over the horizon long enough for environmental assessment to have been well underway. A unique opportunity was offered for assessment and environmental guidelines to precede technological development and operational activities.

The entire environmental effort, prior to 1976, however, was largely unsatisfactory. The Deep Ocean Mining Environmental Study (DOMES) by NOAA (officially begun in fiscal year 1976) has involved close coordination with industry and should provide sound information for future decisions.

DOMES is a component project of NOAA's Marine Ecosystems Analysis (MESA) Program.[108,109] It was designed to identify potential marine environmental impacts to be expected from commercial mining of deep ocean manganese nodules.

Phase I of DOMES officially began in 1976 with some related research conducted in 1974 and 1975. In addition to providing a quantitative baseline, the first phase was to identify major processes controlling the distribution and abundance of marine organisms and to provide information for development of predictive models on the environmental effects of ocean mining. The guidelines resulting from this study, now in preparation, will suggest means of minimizing adverse mining impacts. Phase I field operations ended in November 1976, and the final interpretation of the studies was completed in January 1978. In the meantime, an analysis of potential mining impacts, using information available through mid-July of 1976, was published in April 1977. Baseline studies of Phase I have been carried out at three sites within an area of the Pacific currently considered a primary industry target.

Phase II is designed to monitor the prototype mining equipment tests and to refine the guidelines resulting from Phase I. It will also provide data for refinement of our predictive capability. Phase II began in 1978; the mining industry began its prototype testing early in 1978.

In 1975, the Congress directed NOAA to include assessment of processing facility impacts on land or at sea. Contract reports have been prepared for NOAA.[110] The reports, based on existing available information, identify and describe production facilities that will likely be required by the first-generation nodule mining industry and possible transportation and waste disposal alternatives. Information in these reports will help in assessments of impacts on land and at sea and will be used for followup impact assessments. The possibility exists for some processing at sea, at least in the second-generation efforts. This is another opportunity to assess first and thereby guide development of techniques and sites; the result remains to be seen. Research on environmental effects will no doubt continue to be less than maximally effective until agency jurisdiction is established and a cohesive program adequately funded and implemented.

State of Knowledge Concerning Possible Impacts

There are three broad areas of impact to be dealt with:

- Benthic environment—the seafloor and the life dwelling on it,
- Pelagic environment—the water column and the organisms associated with it, and
- Site processing—at sea or on land.

[106] E. Richardson, op. cit. note 103.
[107] Richard Frank, op. cit. note 24.
[108] Richard Frank, op. cit. note 24.
[109] U.S. Department of Commerce, NOAA. *Management Plan for Marine Ecosystems Analysis (MESA) Program.* Environmental Research Laboratories' MESA Program Office, Boulder, Colo., 1977.
[110] Dames and Moore and EIC Corp. *Description of Manganese Nodule Processing Activities for Environmental Studies,* Volume I, Processing Systems Summary; Volume II, Transportation and Waste Disposal Systems; a contract report prepared for the U.S. Department of Commerce, NOAA Office of Marine Minerals, August 1977.

IMPACTS ON THE BENTHIC ENVIRONMENT

Mining will have both direct and indirect effects on the sea bottom and associated organisms. With the hydraulic system, assuming a unit production of 5,000 metric tons of dry nodules per day, 1.9 square kilometers per day of the seafloor will be mined. A much larger area (25 percent larger) will be required, however, because of unminable topography and areas of low nodule concentration. The mechanical system (continuous line bucket) will directly affect the seafloor along a narrow swath parallel to the ship's track.[111]

Dredging

- An obvious direct impact on marine organisms will be the destruction of a large percentage of those in the path of the nodule retrieval mechanism. The significance of this impact will be determined by the extent of the ocean floor that is mined. If a large enough area is affected, it is possible that species with slow reproductive cycles could be lost (some are thought to require 200 years to reach maturity) from the community in the mined area or even become extinct. This impact could be partially mitigated if mining is strictly regulated so that intermediary patches are left intact between dredge tracts.[112,113]

  The value of protection of these deep-sea organisms is not measured in economic terms or even in terms of their importance in the food web. Their value lies in the fact that they represent a unique assemblage of relict and seldom seen fauna important to the understanding of evolutionary biology. Negligent extinction of these faunal components through our mining efforts would be inexcusable, and careful preventive measures must be taken.

Benthic Discharge Plume

In addition to the effect of the actual dredging, the benthic fauna will be affected by the release of particulates in the near-bottom water column as a result of washing. The hydraulic system will create a specific benthic discharge in the form of a plume containing resuspended bottom sediments, nodule fragments, interstitial water, and benthic biota. Impacts are as follows:

- The principal direct effects of this discharge will result from the resuspension of particulates in the lower water column and their subsequent settlement. Unfortunately, the physical processes controlling the redistribution are not well understood. At least a portion of the particulate matter will likely remain in the lower column and may settle out many kilometers from the disturbance site. The extent of this redistribution is unknown. Localized sedimentation rate will certainly be one to several orders of magnitude higher than normal. We may, therefore, assume that many additional benthic organisms will die as a result. Some will be suffocated as a result of clogging of the respiratory system, others will starve as a result of increase in sediment cover and their inability to burrow to the surface. Many of the smaller fragile forms will be destroyed by even a thin layer of sediment (1 to 2 mm);[114]
- Resuspension and resettling of bottom sediments could increase trace metal content of the sediment surface and adjacent water column. Direct effects will probably be negligible. Indirect effects, however, could be significant. There is evidence in the literature to indicate that heavy metals accumulate in organisms at the various trophic levels. The long biological half-life and the high concentration factors found in many marine species suggest that food web magnification can occur. If this is the case, toxic effects on consumers could then result from feeding on organisms further down in the food web.
- An additional potential effect is the transportation of spores or other dormant life forms by means of sediment resuspension. There is initial information on the possible occurrence of dormant photosynthetic organisms in deep-sea sediments [115,116] and some evidence for activation of these organisms with surface exposure.[117] The implication of this impact is little understood, but it is likely to be relatively insignificant. The survival success of these previously dormant species will depend largely upon their ability to compete with the already well-established species. It has been speculated that they could indeed outcompete the local populations to the detriment of the community and even that they may possess some harmful characteristics. Again, this seems unlikely; however, data should be generated concerning the behavioral nature of these long dormant forms both to increase our understanding of food web stability and to ensure that we avoid speculations characteristic

[111] U.S. Department of Commerce, NOAA. Progress Report—Deep Ocean Mining Environmental Study—Phase I, *NOAA Technical Memorandum* ERL MESA-15, August 1976, 178 pp.

[112] Richard Frank. *Deep Sea Mining and the Environment.* American Society of International Law, Studies in Transnational Legal Policy No. 10, 1976, 54 pp.

[113] National Academy of Sciences. *Mining in the Outer Continental Shelf and in the Deep Sea.* Panel on Occupational Safety in Marine Mining. Marine Board, National Research Council. Washington, D.C., 1975, 119 pp.

[114] U.S. Department of Commerce, op. cit. note 111.

[115] T. C. Malone, et al. "The Possible Occurrence of Photo Synthetic Microorganisms in Deep Sea Sediments of the North Atlantic," *Journal of Phycology* 9: 482–483, 1973.

[116] Op. cit., NAS. note 113.

[117] U.S. Department of the Interior, Draft EIS—Proposed Involvement in Law of the Sea Negotiations Governing the Mining of Deep Seabed Hard Mineral Resources Seaward of the Limits of National Jurisdiction, 1974.

of the andromeda syndrome. Assuming no harmful competition, a new phytoplankton bloom could contribute to reoxygenation of surface waters where oxygen will be used in oxidation of discharged sediment.[118]

Benthic organisms may also be indirectly affected by events taking place within the midwater column and in the surface layers. Necessary nutrient accumulation in the deep-sea environment originates from the surface layers.

In summary, there will be gross mortality of benthic fauna near the disturbance area. The significance of this impact will depend upon the extent and duration of the disturbance and the thickness and rate of resedimentation. Deep-sea faunal succession and recovery rates need further study to enable predictions of long-term effects on the system as a whole.

IMPACTS ON THE PELAGIC ENVIRONMENT

When the sediment and near-bottom water is discharged, either at intermediate depths or at the surface, it will form a discharge plume. Characteristics of this plume have been cited as potential cause for concern.[119,120,121,122]

Productivity

Surface plume models for assessing "worst case" situations have been developed by DOMES. The "worst case" evaluation includes situations where all discharged sediment remains in the surface mixed layer as well as those cases where particles settle through the layer. In this situation:

- Maximum initial direct effects on temperature and disolved solids would be so insignificant that they would be difficult to measure and any resulting biological impacts inconsequential.
- Increases in the concentration of plant nutrients (P04, SI04, and N03) would be almost too slight to even measure, therefore, will likely be insignificant in the long term.[123,124]
- The increased particulate concentration may be of more concern. In the "worst case," without sediment sinking, light penetration will be greatly reduced in the area of the discharge plume and this in turn will reduce productivity by as much as one-half in 24 hours. If one takes sediment settling into account, the above effect is diminished. In any case, there will likely be a decrease in standing stock, the extent of which is unknown, but is expected to be a localized effect not extending further than a few tens of kilometers from the drill ship. The significance of this impact will depend upon dispersion and settling rates, the extent of the mining operation, and its duration. Any large-scale reduction in productivity could obviously have ramifications throughout the ecosystem.
- Depending upon the above occurrences, there could be a reduction in zooplankton standing stock since changes in the phytoplankton community will have corresponding effects on higher trophic levels. The magnitude and significance of this effect are unknown at the present time. Baseline data in the DOMES area indicate a near steady condition for relatively long periods of time between phytoplankton production and zooplankton feeding. Because of this, it is possible that a reduction in productivity will result in a reduction in zooplankton numbers, possibly affecting higher trophic levels.[125] Bathypelagic and deeper living fish could also be affected since they probably depend, at least in part, upon the organic matter generated in the upper layers.[126]

Behavior and Toxicity

Behavior of organisms in response to environmental signals is always of concern in areas where interference may occur as a result of man's activities. It is a well-established fact that many marine species respond to changes in light intensity. For example, many adjust their position in the water column in response to ambient light changes. Little information exists regarding behavior in terms of deep-sea mining impacts. Current information indicates the following:

- Little zooplankton vertical migration occurs in the upper zone of the study area so that decreases in light as a result of surface discharge will not significantly affect migration patterns. Behavioral impacts are in need of further study.[127]
- Increased sediment concentration can affect respiration and feeding of zooplankton by increasing energy expended by filter feeders to capture and assimilate food, by increasing sinking rates of organisms, and by increasing likelihood of trace metal accumulation. Quantitative evaluation of these impacts is not possible with available information.
- Preliminary results from work done by Southwest Fisheries Center (NMFS) Honolulu Laboratory indicates tuna aversion to traversing areas of algal blooms, possibly to avoid turbidity which again raises the question of changes in behavior resulting from alteration of the environment. Down-

[118] Ibid.
[119] National Academy of Sciences, op. cit. note 113.
[120] U.S. Department of Commerce, op. cit. note 111.
[121] Richard Frank, op. cit. note 112, p. 54.
[122] U.S. Department of the Interior, op. cit. note 117.
[123] U.S. Department of Commerce, op. cit. note 111.
[124] W. H. Thomas. "Phytoplankton Nutrient Enrichment Experiments Off Baja, California and in the Eastern Equatorial Pacific Ocean," *Journal of the Fisheries Resource Board of Canada* 26:1133–1145, 1968.
[125] U. S. Department of Commerce, op. cit. note 111.
[126] M. Blackburn. *Review of Existing Information of Fishes in the DOMES Area of the Tropical Pacific.* Final Report NOAA Contract No. 03-6-022-35125. Institute of Marine Resources. University of California, La Jolla, Calif., 1976.
[127] U.S. Department of Commerce, op. cit. note 111.

current plumes could therefore interfere with migrating fish. The degree of impact will depend on the size of the plume and its duration. It should be noted that tuna are characteristic of clear water and are seldom found under turbid conditions.[128,129,130] This could, therefore, indicate a possible effect on the efficiency of longline fishing, although the likely extent is not known at this time.

- Highly mobile fish should, for the most part, be able to avoid high turbidity areas unless they are extremely widespread. The result would be individual deaths from respiratory clogging and interference with feeding behavior. The significance of this impact is unknown, but the effects will likely be short term and localized.
- There will also be possible effects from subsurface turbidity plumes, which may form in association with the pyncocline. The impacts in this instance would involve deeper epipelagic fish including the tuna taken by longlining down to 200 meters. Mobile epipelagic fish would move away from the layers with little mortality. Vertically migrating mesopelagic fish will encounter these turbidity layers and may not pass through them in which case they would tend to move out of the area of their occurrence. The presence of these turbid layers will result in some mortality, but the overall effect on populations and community structure is unknown.
- Both benthic and pelagic filter feeding organisms will ingest sediment particles and incorporate them into fecal pellets. It is not known to what extent this will be beneficial in clearing the water and increasing settling rates minimizing impacts on other organisms, nor is it known what effects, if any, this will have on the food web. It is, however, another avenue into the system for toxic substances.
- Increased sediment will provide additional substrata for bacterial growth that could then use the dissolved organic matter in seawater. Studies are underway (DOMES) to investigate bacterial growth on the particles using dissolved organic matter. If bacterial growth resulted in greater use of the dissolved organic matter, this, in combination with discharge of bottom water in the lower dissolved organic matter concentrations, could become limiting. Whether or not this is a potential problem is little understood, and opinion is divided. The studies should provide some insight.

The above has been a description of the qualitative effects on benthic and pelgaic biota as a result of deep-sea mining. Our ability to assess impacts will improve as additional data from the DOMES effort become available. It should be emphasized that the value of biological information does not lie in the ability to say "some organisms will die as a result of these activities." The value to the decision maker lies in the ability to provide an assessment of the significance of this destruction to the long-term health of the ecosystem.

It is likely that the most significant unanswered questions center around the effects of the resuspended sediment in the surface plumes at the pycnocline and in the benthic plume.

IMPACTS OF PROCESSING

Little or no information is available on the potential environmental effects associated with transportation and processing of manganese nodules. In view of this, and to complement the DOMES at-sea research, NOAA has contracted for studies to characterize possible onshore and offshore processing methods and likely transportation and waste disposal activities. These descriptive works were published in August 1977.[131] Followup phases of the NOAA program will use data from these reports to analyze potential environmental impacts.

Impacts from land transportation will depend upon the method used. Potential modes include the haul system, conveyor, slurry pipeline, and trucking. Resulting impacts will likely be slight, barring accidents. The major environmental problems will center around waste treatment and disposal. The largest portion of mineral process wastes consist of finely ground rock slurried with liquid waste (tailings). Six alternative disposal methods have been described.[132] Of these, three are felt to be the most likely for first-generation activities. These are disposal in a landfill, disposal in a conventional slurry tailings disposal system, and disposal by deep-ocean dumping. Careful impact evaluation will have to be done on all viable alternatives in order to ensure selection of an environmentally sound method and strict environmental and safety regulation.

At-Sea Processing

Though indications are that first-generation operations will use onshore processing, the possibility still exists for these activities to take place at sea.

There are three general options for processing at sea:

- Physical benefication.
- Partial processing to produce an intermediate product, and
- Full at-sea treatment to finished products.

[128] H. Yabe, Y. Yabuta, and S. Ueganagi. "Comparative Distribution of Eggs, Larva, and Adults in Relation to Biotic and Abiotic Environmental Factors, *FAO Fish Report* 6(3):979–1009, 1963.

[129] G. W. Bane. The Distribution of Abundance of Tunas and Tuna Bait Fishes in the Gulf of Guines. Thesis: Cornell University, Ithaca, N.Y., 1961, 119 pp.

[130] G. I. Murphy. "Effect of Water Clarity on Albacore Catches," *Limnology and Oceanography* 4:86–93, 1959.

[131] U.S. Department of Commerce, op. cit. note 111.

[132] U.S. Department of Commerce, op. cit. note 111.

Incentives that may stimulate mine site processing are:

- Savings in transportation costs, that is, shipping a more concentrated product.
- Cost and siting of waste disposal for land-based processing facilities.

The first of these alternatives, physical beneficiation, would be economically attractive. Tailing wastes would be disposed of at sea, and the upgraded nodule material further processed on land. Tests have demonstrated, however, that manganese nodules do not lend themselves to this method without additional chemical treatment. The third alternative would likewise require the development of new technology. Partial processing, therefore, seems to be the only option likely in the near future.

There are several possible methods of partial processing at sea. They would involve production of an impure metal precipitate at sea with the following purification and final production on land. At-sea disposal of wastes would likely be necessary for economic viability. This will require careful environmental regulation.

Impact assessment should focus on waste disposal, discharge or accidental spillage of caustic reagents, and the energy source, whether it be fossile fuel or nuclear.[133,134,135]

Onshore Processing

Impacts from onshore processing will differ considerably. Potential impacts will be associated with transportation from the mining site to seaports, including transfer from mining ships to transport vessel, and return of fuels and supplies from shore to mining ship. There will be impacts in the area of the port facilities for receipt of nodules, storage, and the start of inland transportation. This could involve onshore and/or offshore terminals with their attendent effects. The type of terminal will depend upon whether the nodules are in slurry, whole, or dried and ground.

---

[133] U.S. Department of Commerce, op. cit. note 109.
[134] Richard Frank, op. cit. note 24.
[135] Richard Frank, op. cit. note 112.

Chapter VII: Marine Science and Technology

Often referred to in tandem, marine science and technology are separate but closely-coupled processes. Science provides the key to understanding the oceans and contributes, with engineering, to the development of technology. Technology is the key to expanded marine operations, and its elements are used in scientific investigations as well as in economic and other activities unrelated to science.

Before World War II, U.S. marine science was largely the province of the universities. Through the 1920s, the bulk of the marine research effort was carried out at a few small coastal laboratories used by university biologists and their students. Then, in the late 1920s, the National Academy of Sciences began calling attention to a research deficiency in oceanography. In 1930, the Rockefeller Foundation responded with $6 million in grants for the construction of oceanographic laboratory facilities. As a result, three major centers of ocean science were developed: the Scripps Institution of Oceanography, the Oceanographic Laboratories of the University of Washington, and Woods Hole Oceanographic Institution.

Until World War II, endowments, funds from foundations, and other private sources, as well as allocations from State university budgets, sustained the research of these three laboratories plus the oceanographic work of a few small biological stations. The oceanographic activities of the Federal Government were, at that time, limited almost entirely to fisheries investigations and to surveys for mapping and charting.

The character of U.S. science was drastically altered during World War II by the infusion of Federal funds into scientific projects having military applications. When the wartime organization of science was disbanded, marine science and technology might have returned to the comparatively small-scale privately funded efforts of the prewar era had it not been for the initiation of a Navy program to provide support for research and development in areas of Navy interest. The availability of this funding was responsible for continued rapid growth of the marine sciences in the postwar period.

In the 1950s, Navy support of science, including the marine sciences, leveled off. From 1947 to 1957, the Navy increased its funding of basic research by 50 percent, about the same percentage that the cost of support per scientist increased. Although additional support became available from the Atomic Energy Commission, the Department of the Interior's Bureau of Commercial Fisheries, and the National Science Foundation, the growth rate of the marine sciences declined in the 1950s.

In 1957, the International Geophysical Year and the launching of Sputnik I by the Soviet Union provided a new impetus for U.S. science efforts, including those directed to understanding and making use of the oceans. In the decade that followed, Federal support of oceanography expanded rapidly. The major emphasis of these efforts, however, continued to be on research, both basic and applied, and on such supporting elements as instrument development and the construction and maintenance of ships and shore facilities. Surveys and other use-oriented services accounted for only 15 to 25 percent of the entire Federal ocean program at that time.[1] After 1966, a number of services and engineering and technology activities, as well, were added to the Federal ocean agenda. Since 1970, additional ocean functions that emphasize management and conservation of ocean resources have been undertaken by the Federal Government.

Trends in the National Scientific Effort

The development of marine science and technology must be considered in the context of the trends in U.S. science policy in general. Expenditures and obligations for the funding of science and engineering activities have commonly been used as indicators of national scientific commitment. It should be remembered, however, that they are measures of input rather than output, and as such are imperfect estimates of achievement.

The National Science Foundation (NSF), however, uses a series of useful indices that track the

[1] Interagency Committee on Oceanography of the Federal Council for Science and Technology. *National Oceanographic Program for Fiscal Year 1962*, and fiscal years through 1967. ICO Pamphlet numbers 2, 3, 11, 15, 17, and 24. Washington, D.C., U.S. Navy, annually 1961–66.

general course of science and technology development and reflect the changing character and comparative stature of U.S. research and development (R&D) in the context of worldwide trends.[2] Unfortunately, the level of integration of the data used by NSF in *Science Indicators* prohibits the identification of marine science and engineering as a functional entity.

National and International Trends in R&D Funding

Historically, total national R&D expenditures grew at a steady linear rate of approximately one-half billion dollars annually from World War II through 1956.[3] In 1957, the annual rate of expenditure increased significantly (fig. 7–1). Since that time, a

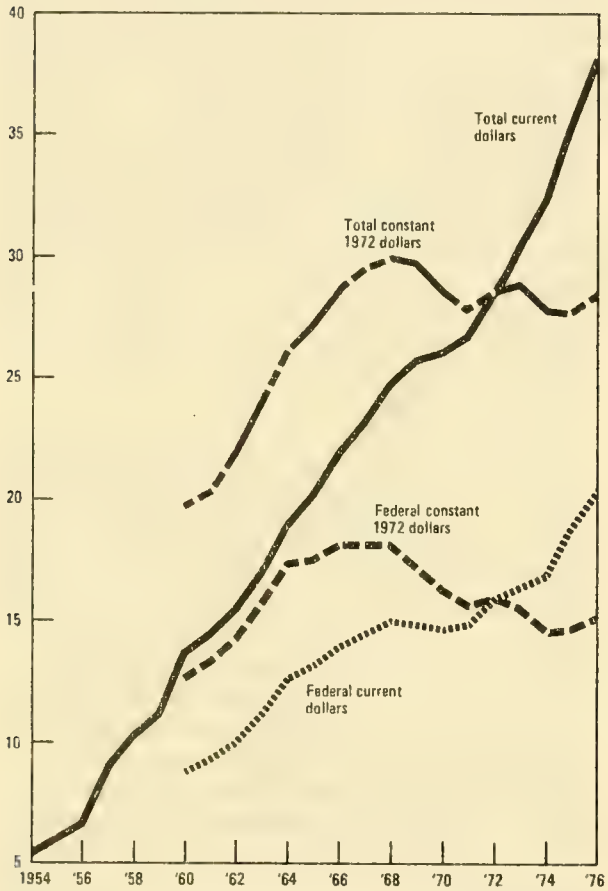


Figure 7–1.—National R&D expenditures 1954–76 (billion dollars). Source: Science Indicators 1976, National Science Board, 1977, p. 206, p. 208.

strong commitment to the national science effort has continued, with a steady increase in R&D funds. Inflation, however, has eroded the purchasing power of the research dollar so that in terms of constant dollars, i.e., current dollars adjusted by GNP implicit price deflators, R&D has been level-funded since 1967 or has slightly declined.

Federal funds for R&D increased in current dollars in all but two of the years between 1960 and 1976, reaching their highest level, over $20 billion, in 1976; funding in constant dollars, however, peaked in 1967, had declined 20 percent by 1974, and then rose 3 percent to the 1976 level (fig. 7–1).

In the meantime, 1960–76 R&D funds provided by industry rose more rapidly than those of the Federal Government, reaching $16.5 billion in current dollars in 1976; these funds in constant dollars were at their highest level in 1976, although there had been a rise of only 1.5 percent since 1973.

The proportion of the Gross National Product (GNP) expended for research is regarded as a universal index of the national commitment to science and technology. According to this indicator, the

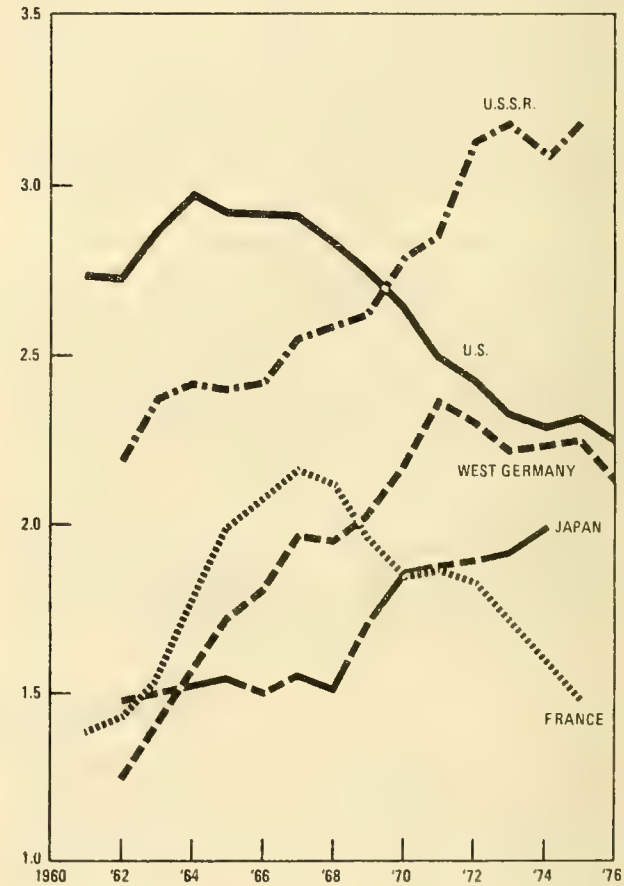


Figure 7–2.—R&D expenditures as a percentage of gross national product 1961–76 (percent). Source: Science Indicators 1976. National Science Board, 1977, p. 184.

[2] National Science Foundation, *Science Indicators, 1967: Report by the National Science Board*. Washington, D.C., Government Printing Office, 1977.

[3] "Research and Development" as used herein means basic and applied research and development activities.

fraction of the U.S. GNP devoted to R&D has diminished steadily over the last decade, falling nearly 25 percent from its peak in 1964, although the United States still leads all of the major R&D-performing countries with the exception of the Soviet Union. The U.S. decline is largely due to the reduced growth of expenditures by the Federal Government for R&D in defense and space exploration.[4] While the proportion of the GNP spent for R&D by the United States has declined significantly during the past 14 years, the percentage increased substantially in the USSR, West Germany, and Japan (Fig. 7–2). In 1974, the proportion of GNP directed to R&D was 2.3 percent in the United States, compared with 3.1 percent in the Soviet Union, 2.2 percent in West Germany, and 2.0 percent in Japan. France is the only other industrial country evaluated that has shown a long-term decline in percent of GNP devoted to research.

The implications of R&D funding based on the NSF indicators suggest continued strong general support for R&D activities. However, if general expenditures for R&D continue to decline in terms of constant dollars, it may be necessary to make some difficult decisions respecting research priorities. Disregarding the massive commitments to "glamour" programs, such as space exploration and nuclear energy, Federal R&D funding has been more or less proportionately distributed among competing research activities.[5] Significant commitments of Federal funds to energy R&D in an all-out effort to develop alternative energy sources could again result in an expanded R&D budget skewed toward energy application. Nonscience priorities, on the other hand, could co-opt potential Federal growth funds, thus either maintaining the status quo or heightening the competition for an even smaller piece of the constant-dollar Federal budget.

Trends in Marine Science and Technology Funding

For data on ocean-related R&D expenditures, one must rely on the data included in the *National Oceanographic Program,* which was compiled by the Interagency Committee on Oceanography (ICO) through 1966; the data subsequently provided in *Marine Science Affairs,* which was published by the Marine Science Council until its termination in 1971; and the data now included annually in the *Federal Ocean Program.* Unfortunately, inconsistencies in the definition of marine science and engineering programs in the Federal budget and changes in the accounting procedures of Federal agencies prevent exact comparability among the time series data.

During the period 1968–77 national R&D expenditures in terms of constant dollars continued their general decline (fig. 7–1); ocean-related R&D, on the other hand, remained steady over the same period (fig. 7–3). The activities identified in the "ocean research" and the "ocean engineering" categories of the budget tabulations in the *Marine Science Affairs* and *Federal Ocean Program* reports (fig. 7–3) are assumed to approximate, but not wholly reflect, Federal expenditures for marine science and technology.

Because ocean-related R&D is but a small subset of the total Government-wide R&D program, oscillations in year-to-year funding are more pronounced. The surge of funding which spanned the 2-year period between 1970 and 1972 coincided with increased expenditures by NSF for the International Decade of Ocean Exploration (IDOE) and additional obligations for expanded research facilities and capital equipment. The inclusion of capital outlays in

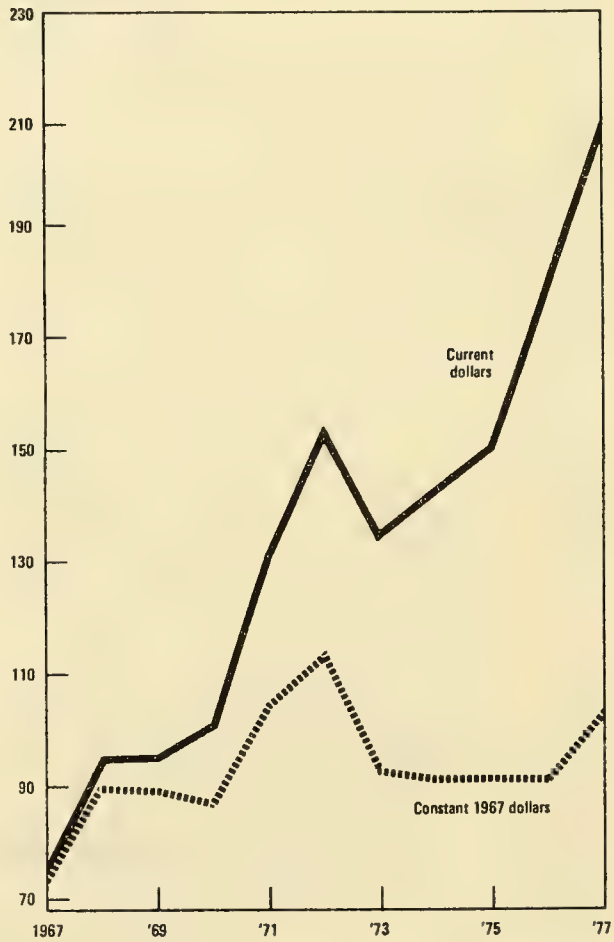


Figure 7–3.—Federal expenditures for marine-related R&D 1967–77 (million dollars).

[4] NSF, op. cit. note 2, p. 4.
[5] NSF, op. cit. note 2, p. 41.

the aggregate expenditures for marine science and technology tend to mask the trends in long-term R&D financing. Similarly, the logistical costs of research, e.g., expenditures for the maintenance and operation of ships and facilities, while they contribute to the research effort, are fixed costs that tend to increase over time, but which cannot be considered legitimately as increases in research effort.

For practical purposes, funding for ocean-related R&D in terms of constant 1967 dollars has been nearly level since 1968 if the short-term increase in funding in 1971–72 is discounted (fig. 7–3). Expenditures for all activities included in the Federal Ocean Program followed a similar trend, with funding in terms of constant 1967 dollars increasing slowly over the past decade (fig. 7–4).

Structure of Marine Science and Technology—Perspectives of the Field

Science is often categorized in quasi-independent elements: "basic" and "applied"; "mission-oriented" and "nonmission-oriented"; "big" and "little." Science is also categorized by performer. Each category has a constituency, each has its patronage, and each plays an important role in the R&D continuum.

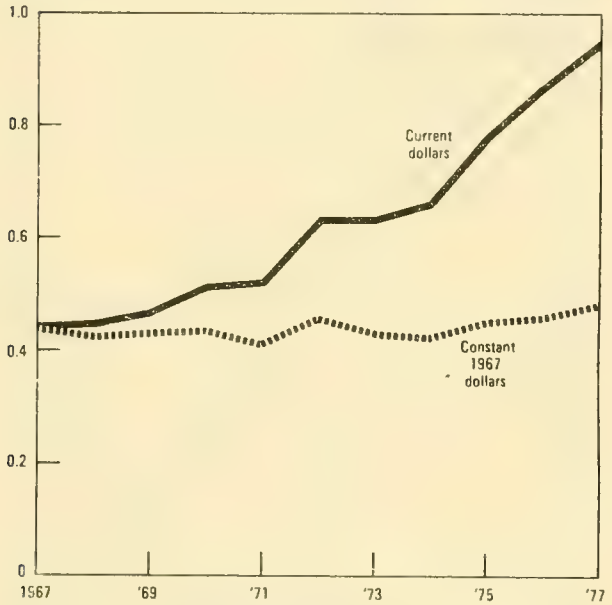


Figure 7–4.—Expenditures for the total Federal Ocean Program 1967–77 (billion dollars).

The high cost of equipment, ships, and laboratory facilities have created a situation where only the Federal Government and industry can afford to support marine science and technology. But industry resources are directed toward profit-making activities, and there are limits to Federal funds available for R&D. Thus, the issues in Federal support of ocean-related R&D often hinge on the allocation of the Federal ocean R&D budget among competing but complementary scientific activities. There are few benchmarks to determine how much basic or applied science is enough. Similarly, there are no precise performance standards to determine whether the cost effectiveness of university-based research is greater or smaller than Federal laboratory-based research. Equally difficult to decide is: what kind and how much research and development should be underwritten by the private sector vis-a-vis the Federal Government?

Much of the controversy over the distribution of support between basic and applied science arises from the persistent concern by the general academic community that basic science is not receiving a fair share of the total R&D budget. If indeed there is a mismatch between the basic science budget and the total science budget, it may be partly because potential applications often underlie the private and public support of basic science, yet the value of any given piece of work often does not become fully apparent until years after it is published.

A comparison of total R&D expenditures (fig. 7–1) with basic research expeditures (fig.7–5) reveals that both rose continually during the 1960–76 period as measured in current dollars; in constant dollars, funds for both in 1975 were at about the 1965 level. This level for basic research was 12 percent lower than the peak year of 1968; for all R&D, the 1975 level was 7.5 percent below 1968. In 1976, basic research expenditures rose 1.6 percent in constant dollars, while total constant dollar R&D expenditures rose 2.9 percent (fig. 7–1).

The Federal component of R&D expenditures follows a pattern similar to the national. The Federal pattern, however, is somewhat more favorable to basic research. In constant dollars, total Federal expenditures for R&D peaked in 1967, dropped 20 percent to a 1975 low, and then rose 3 percent in 1976. Federal constant dollar support for basic research peaked in 1968, dropped 16 percent to the 1975 low, but rose only 1 percent in 1976. The difference between the trends for all R&D and for basic research reflects the fact that industry, which provides over 40 percent of total R&D support, continued to expand its activities in the applied sciences and engineering. Meanwhile, the share of the R&D dollar allocated to basic research by the Federal Government, which contributed over two-

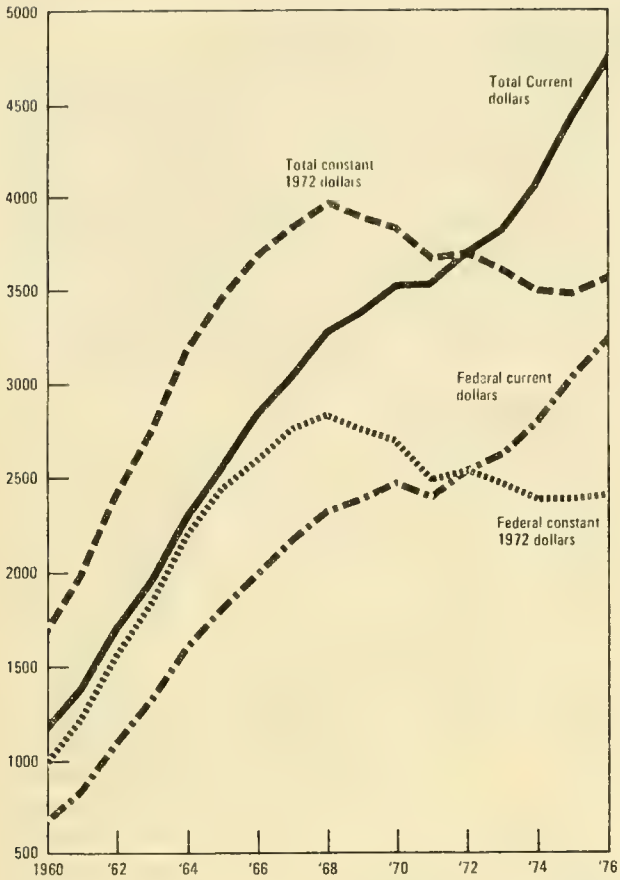


Figure 7–5.—Basic research expenditures 1960–76 (million dollars). Source: Science Indicators 1976, National Science Board, 1977, p. 211.

thirds of all basic research funding, has remained about the same.

Industry, like the academic community, has expressed concern about the role of the Federal Government in R&D. Industry's concern is that Federally sponsored projects may transcend the imaginary line that separates nonmarket-oriented technological innovation from market-oriented commercial development. On the other hand, industry is also concerned that Federal regulatory actions may be based on limited technological expertise.

As in marine science, which includes both applied and basic research, ocean technology includes both short-term development for application to immediate problems and general purpose engineering and technology to lay the basis for long-range development. The need for a broad base of ocean technology, not directed to specific applications but useful to a wide spectrum of ocean development activities, has been recognized by a number of Government advisory groups representing industrial and academic interests.

While the responses of Government, academe, and industry are to some extent self-serving, it is fundamental to the development of consensus on the optimal apportionment of resources and responsibility within the U.S. research establishment. The relative roles of each sector in the support and conduct of marine science and technology are not mutually exclusive, they tend to overlap throughout the R&D process (table 7–1).

The Stratton Commission cautioned that "it is essential that the distinction be clearly made between what private industry should do for itself under profit motivation and what the Government should do to assist." [6] The distinction between governmental function and private function is unfortunately not that clear. A fuzzy line of demarcation separates their respective roles. If the process of innovation is short-circuited too soon by terminating Government involvement before industry is capable of nurturing the innovation, the economic return on the Government's R&D investment may not be realized.

There are three instances where the Federal Government has extended its role into the technological development process beyond the frontier that normally divides governmental activities from private activities: (1) in the case of disaggregated industries, e.g., agriculture, fisheries, and medicine, where the structure of the private sector sometimes discourages applied R&D because of lack of capital and expertise, or where industry has no incentive to develop new information that would be available equally to competitors as well as sponsors of the research; (2) where the Government is the consumer of the technology, e.g., defense systems, space technology, and undersea technology; and (3) in instances where support of long-range, high-risk, high-priority technology is clearly in the national interest, e.g., nuclear technology and ocean thermal energy conversion.

[6] Report of the Commission on Marine Science, Engineering, and Resources to the President of the United States and the U.S. Congress, by Julius A. Stratton, Chairman. *Our Nation and the Sea—A Plan for National Action.* Washington, D.C., Government Printing Office, 1969, p. 39.

Federal Marine Science and Technology Establishment

Marine science and technology efforts are supported by 21 organizations in 6 departments and 5 independent agencies. The unstated policy of the U.S. Government has been to couple specific R&D activities to the management and regulatory responsibilities of individual agencies. This tendency reflects the recognition that marine science and technology is important in meeting agency operational requirements.

Table 7–1.—Current roles of the Federal, academic, and industrial sectors in marine science and technology [1]

Activity	Federal Government	Academic institutions	Industry
Research:			
	Lead and support the Nation's overall marine science and technology program.	Provide an academic atmosphere, scholarly competence, and infrastructure for research and education.	Support and conduct sufficient basic research to achieve entrepreneurial goals.
	Fund basic and applied research at academic institutions.	Initiate and perform basic research funded with Federal and nongovernmental funds.	Perform applied research necessary for commercial purposes.
	Provide "big science" facilities, including support of the oceanographic fleet and national laboratory facilities.	Undertake a balanced proportion of appropriate applied, problem-oriented R&D.	
	Conduct problem-oriented applied and basic research within the mission agencies.		
	Promote interdisciplinary research with problem-focus and provide managerial leadership for major problems of national interest.		
Innovation of technology:			
	Develop scientific, exploratory, and survey information.	Address appropriate multidisciplinary, regional R&D problems that are less than national in scope.	Develop technology through processes of innovation to produce a commercially marketable commodity or service.
	Undertake appropriate engineering development in certain high-risk, high-priority areas that are in the national interest and where private sector probably would not invest.		
	Disseminate information, including mapping and charting products and data, and transfer technology to appropriate users.		
	Provide limited technological and advisory services, including mapping and charting, to promote innovation and development in the private sector.		
Education:			
	Provide support to academic institutions for ocean-related R&D that serves a dual function for graduate and undergradute training.	Provide graduate and undergraduate training in the ocean-related sciences and engineering.	
	Fund programs for developing academic capabilities in marine R&D.		
Commercialization:			
			Supply entrepreneurial factors to implement the commercial use of the product.

[1] NOTE: This table outlines the more important roles of the Federal Government, academic institutions, and industry. The natural roles of the three sectors are neither as limited nor compartmentalized as shown. The States are minimally involved in R&D, but omitted from the table. They use research findings and technological developments in management and regulatory decisions.

The agencies of the Federal Government are organized to provide services and regulate activities that achieve national goals. In agencies whose missions require a high degree of science and technology, research and development is a major component of many programs. Many of the agencies having ocean-related missions are in this category.

While no clear distinction can be made between the research objectives of the Federal mission agencies and the university research enterprise, their respective roles have been described in terms of the dichotomy between applied research—the role of the Federal laboratories—and basic research—the primary role of the universities and academic research institutions. Actually, the basic and applied functions tend to be commingled in Federal, university, and industrial laboratories, and each contributes to the "whole" of science and technology, notwithstanding their traditionally described roles. Thus, it is neither useful nor accurate to attempt to define the respective roles of the Federal, university, and private sectors on the basis of either basic or applied research.

Federal Research Laboratories

Established to support the mission research of the Federal agencies, Federal research laboratories are the focal point for the in-house research programs of the ocean agencies (table 7–2). Federal laboratories range from small, single-purpose research facilities associated with academic institutions, to regional field facilities focusing on local problems. Some, such as the national laboratories operated by the Department of Energy and the NASA laboratories, are vast research complexes with broad research missions that require sophisticated equipment and high capital cost.

The number of Federal laboratories increased dramatically during World War II, and in the post-war period as the Nation undertook a massive R&D program and sought to solve its environmental problems. Although some Federal laboratories conduct basic investigations in areas of agency interest, most of their work is problem-oriented to meet mission requirements.

In 1974, the investigating staff of the House Committee on Appropriations cited a number of examples of laboratory management that "clearly depict the underutilization, overbuilding, and duplication of facilities and programs plaguing the Government's research efforts." [7] The staff singled out the Department of Defense as the only agency centrally identifying in-house research and development resources and activities. Since 1966, the annual management analysis of the Director of Defense Research and Engineering has included comprehensive data on funding, manpower, and facilities, as well as brief descriptions of each activity's mission, current problems, functions and equipment capabilities.[8] In contrast, the Appropriations Committee staff found that neither the Department of Commerce nor the National Oceanic and Atmospheric Administration (NOAA) had long-range facility planning mechanisms.[9]

In response to the findings of the House Appropriations Committee investigation, NOAA formulated a long-range plan for its laboratory facilities. The *Facilities Master Plan,* completed in January 1975, describes the condition of the physical plant and equipment of each facility and assesses the need to update or otherwise improve the operation, including time and cost factors involved.

Problems similar to those raised by the Appropriations Committee investigation were identified by the Stratton Commission, which concluded that many in-house laboratories were "too small to mount effective programs" and recommended "strengthening them by adequate funding and staffing." The Commission suggested that there be a "selective consolidation of marginal laboratories." [10] Since that time, NOAA's National Marine Fisheries Service (NMFS) and the Navy, the two organizations operating the greatest number of laboratories, have consolidated several laboratories and closed others.

NOAA Laboratories

The most extensive agency network of marine science laboratories is that of NOAA, whose NMFS has 26 laboratories distributed along all the Nation's coasts. Four of these laboratories are engaged in the improvement of fishery products technology, and one is involved in developing techniques for aquaculture. The remaining laboratories, coupled with the NOAA fisheries research fleet, perform basic biological and environmental research as well as applied fisheries investigations.

In addition to the NMFS laboratories, 14 laboratories are managed by six other NOAA mission elements: The Environmental Research Laboratories (ERL), the National Ocean Survey (NOS), the National Environmental Satellite Service (NESS), the Office of Ocean Engineering (OOE), the National Weather Service, and the Environmental Data Service. Seven of the fourteen are ERL laboratories. ERL facilities are, in most instances, located at

[7] U.S. Congress, House Committee on Appropriations. Utilization of Federal Laboratories. Hearings before the Subcommittee on Agriculture-Environmental and Consumer Protection 93d Congress, 2d Session, Pt. 6 p. V. III.

[8] Ibid., p. 6.

[9] Ibid., p. 28.

[10] *Our Nation and The Sea,* op.cit. note 6, p. 29.

Table 7–2.—Federal laboratories conducting research related to marine science and engineering

Department or agency facility and location	Function
DEPARTMENT OF COMMERCE (DOC)	
National Oceanic and Atmospheric Administration (NOAA)	
National Marine Fisheries Service (NMFS)	
Northwest and Alaska Fisheries Center Seattle, Wash.	Research on living marine sources in temperate and subarctic Northeast Pacific Ocean.
Northwest and Alaska Fisheries Center, Marine Mammal Division, Seattle, Wash.	Research on northern fur seal of Pribilof Islands.
Auke Bay Fisheries Laboratory Auke Bay, Alaska	Research directed toward establishing limits and biological productivity of living marine resources in waters adjacent to Alaska.
Kodiak Laboratory, Kodiak, Alaska	Studies on problems related to fish and shellfish processing and quality and studies of parameters affecting mortalities during live holding of crab.
Seattle Laboratory, Seattle, Wash.	Research and development on improved use of marine resources.
Southeast Fisheries Center, Miami, Fla.	Conducts fishery, biological, oceanographic, and chemical research.
Pascagoula Laboratory, Pascaguola, Miss.	Conducts resource surveys and biological fisheries research to assess underutilized fisheries resources.
National Fisheries Engineering Laboratory, Bay St. Louis, Miss.	Advance fishery technology.
Galveston Laboratory, Galveston, Tex.	Shrimp aquaculture research and technology.
Panama City Laboratory, Panama City, Fla.	Research on biology and ecology of coastal marine fishes.
Port Aransas Laboratory Port Aransas, Tex.	Biology and ecology of coastal marine fishes.
Beaufort Laboratory, Beaufort, N.C.	Resource evaluation of Atlantic and Gulf menhaden and marine fishes of natural and artificial reefs.
College Park Laboratory, College Park, Md. (relocating to Charleston, S.C. 3/78)	Research in fishery technology.
Northeast Fisheries Center Woods Hole, Mass.	Research and development relating to stocks of fish supporting sport and commercial fisheries in Northwest Atlantic.
Narragansett Laboratory, Narragansett, R.I.	Basic research in larval fish and invertebrate physiology and taxonomy and gamefish ecology.
Milford Laboratory, Milford, Conn.	Determine effects of environmental factors on marine resources of New England waters.
Oxford Laboratory, Oxford, Md.	Fishery biology and management; diseases, pathology, ecology and life history.
Sandy Hook Laboratory, Highlands, N.J.	Research in marine fisheries, biological oceanography and estuarine ecology.
Gloucester Laboratory, Gloucester, Mass.	To improve quality, quantity and variety of marine products reaching the consumer.
National Systematics Laboratory Washington, D.C.	Research on taxonomy of selected kinds of marine and aquatic organisms.
Atlantic Environmental Group Narragansett, R.I.	Conduct marine environmental studies, provide oceanographic and meteorological data, and interpret data and interrelationships for use in fisheries and environmental forecasting.

Table 7–2.—Federal laboratories conducting research related to marine science and engineering (continued)

Department or agency facility and location	Function
DEPARTMENT OF COMMERCE (DOC)	
National Oceanic and Atmospheric Administration (NOAA)	
Southwest Fisheries Center, La Jolla, Calif.	Research and management studies for commercial and sport fisheries.
Honolulu Laboratory, Honolulu, Hawaii	Study of high-seas tropical pelagic fishery resources.
Tiburon Laboratory, Tiburon, Calif.	Conducting studies on living resources and their environment of coastal waters of Southwest Region of NMFS.
Pacific Environmental Group Monterery, Calif.	Conduct marine environmental studies, provide oceanographic and meteorological data, and interpret data and interrelationships for use in fisheries and environmental forecasting.
National Seafood Quality and Inspection Laboratory, Pascagoula, Miss.	Conduct and coordinate chemical, physical, microbiological, public health, nutritional, engineering, and food-processing research studies to provide measurements and standards of seafood quality and sanitary handling.
Environmental Research Laboratories (ERL)	
Boulder Environmental Research Laboratories, Boulder, Colo.	Research related to lower and upper atmosphere, space environment, and solid earth.
Pacific Marine Environmental Laboratory Seattle, Wash.	Research toward a fuller understanding of ocean basins and borders.
Joint Tsunami Research Effort Honolul, Hawaii	Research on transfer of earthquake energy to tsunami energy and propagation.
Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.	Research on ocean basins and borders, oceanic processes and ocean-atmospheric interactions.
Geophysical Fluid Dynamics Laboratory Princeton, N.J.	Investigations of dynamics and physics of geophysical fluid systems.
National Hurricane and Experimental Meteorology Laboratory, Miami, Fla.	Develops experimental methods to change atmospheric processes artificially and in a reproducible manner.
Great Lakes Environmental Research Laboratory, Detroit, Mich.	Define present condition of Great Lakes.
National Ocean Survey (NOS)	
Geodetic Research and Development Laboratory, Rockville, Md.	Carries out research and development in geodesy in support of operations directed towards improving accurate determination of earth's configuration and distributing of mass.
Enginering Development Laboratory—Ocean Engineering Branch, Miami, Fla.	Development of ocean structures and platforms in support of data acquisition of NOAA.
Engineering Development Laboratory Rockville, Md.	Provides design, development, and test of data acquisition and processing systems for use in ocean environment.
Office of Ocean Engineering (OOE)	
NOAA Data Buoy Office Bay St. Louis, Miss.	Research, development, test and evaluation of a spectrum of data buoys with sensors, power supplies, hull sizes, and data processing and communications systems.
National Environmental Satellite Service (NESS)	
Spacecraft Oceanography Project Suitland, Md.	Research and development in application of aerospace remote sensing techniques to oceanography.

Table 7–2.—Federal laboratories conducting research related to marine science and engineering (continued)

Department or agency facility and location	Function
DEPARTMENT OF COMMERCE (DOC)	
National Oceanic and Atmospheric Administration (NOAA)	
National Weather Service (NWS)	
Techniques Development Laboratory Silver Spring, Md.	Hurricane ocean surge research and development.
Environmental Data Service (EDS)	
Center for Experiment Design and Data Analysis (CEDDA), Washington, D.C.	Provides data management, interpretation, and analysis to meet national and international needs for atmospheric and marine environmental assessment.
Maritime Administration (MarAd)	
National Maritime Research Center Kings Point, N.Y.	Support of Maritime Administration through test and evaluation of systems and components.
DEPARTMENT OF DEFENSE (DOD)	
U.S. Army	
Coastal Engineering Research Center Washington, D.C.	Provides research and development assistance in accomplishment of civil works programs of Corps of Engineers.
Waterways Experiment Station Vicksburg, Miss.	Conduct models of estuaries and other seashore areas for the study of local water processes.
Chesapeake Bay Hydrolic Model Kent Island, Md.	Study Chesapeake Bay water processes.
U.S. Navy	
Civil Engineering Laboratory Port Hueneme, Calif.	The principal Navy research, development, test, and evaluation center for shore and sea floor facilities and support of Navy and Marine Corps construction forces.
Naval Research Laboratory Washington, D.C.	Conduct scientific research and development in physical sciences and related fields directed toward new and improved materials, equipment and techniques, and systems for the Navy.
Naval Ship Research and Development Center, Bethesda, Md.	The principal research, development, test, and evaluation center for Naval vehicles; also provides support for the Maritime Administration and the maritime industry.
Naval Coastal Systems Laboratory Panama City, Fla.	Application of science and technology associated with military operations carried out primarily in coastal regions.
Naval Submarine Medical Research Laboratory, Groton, Conn.	Conducts medical research and development as it relates to submarine, shipboard, and diving environments.
Naval Underwater Systems Center Newport, R.I.	Principal Navy research, development, test, and evaluation center for underwater weapons systems.
Naval Arctic Research Laboratory University of Alaska Barrow, Alaska	Provide facilities and services for accomplishing those programs of basic and applied research which contribute to successful Navy operations in arctic regions.
U.S. Naval Oceanographic Office Bay St. Louis, Miss.	Collect, analyze and display oceanographic data in support of fleet operations and shore establishments; improve methods of oceanographic prediction, data collection, and data analysis; perform other related research, development, testing, and evaluation.
Naval Ocean Research and Development Activity, Bay St. Louis, Miss.	Provide a full spectrum of ocean science support for Navy research and development programs; provide ocean science program management in oceanographic research and development; develop and recommend an annual Navy plan in ocean science; conduct related research and development programs.

Table 7–2.—Federal laboratories conducting research related to marine science and engineering (continued)

Department or agency facility and location	Function
DEPARTMENT OF DEFENSE (DOD)	
U.S. Navy	
Naval Environmental Prediction Research Facility, Monterey, Calif.	Ocean environmental prediction modeling research.
Navy Medical Research Institute Bethesda, Md.	Environmental health effects studies and analyses; contributes to Navy underwater operations.
Naval Air Development Center Warminster, Pa.	Engineering research, development, and testing in support of weapons systems.
Naval Ocean Systems Center San Diego, Calif.	Conducts research, development, testing, and evaluation of systems and techniques to improve the effectiveness of Navy ocean operations.
Naval Ordinance Laboratory, White Oak, Md.	Studies hardware responses to environmental factors in support of weapons systems.
Applied Research Laboratory Pennsylvania State University University Park, Pa. (not Navy-owned; under continuing Navy contract)	Research and development in underwater systems for torpedos, hydrodynamics, and acoustics.
Applied Physics Laboratory University of Washington, Seattle (not Navy-owned; under continuing Navy contract)	Research, development, test, and evaluation in areas of acoustics, targets and training devices, acoustic lenses, ocean physics and ocean engineering.
ENVIRONMENTAL PROTECTION AGENCY (EPA)	
Western Fish Toxicology Field Station Corvallis, Ore.	To develop toxicology data for anadromous fishes and their food organisms indigenous to Pacific Northwest Region, with major emphasis placed on measuring safe levels for salmon.
National Marine Water Quality Laboratory Narragansett and West Kingston, R.I.	To determine water quality requirements for use of marine waters and to recommend water quality criteria.
Gulf Breeze Environmental Research Laboratory, Gulf Breeze, Fla.	To conduct and manage research on ecological effects of pesticides and other hazardous organisms.
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (HEW)	
Food and Drug Administration (FDA)	
Gulf Coast Technical Services Unit Dauphin Island, Ala.	Provide technical assistance to States and regional offices and conduct research on public health aspects of shellfish sanitation.
DEPARTMENT OF THE INTERIOR (DOI)	
Fish and Wildlife Service (FWS)	
Fish Pesticide Research Laboratory Columbia, Mo.	Research on effects of pesticides on fishes.
Ashland Biological Station, Ashland, Wis.	Lake trout assessment, lake trout-sea lamprey relationships, life history studies on brown trout, and limnology studies.
Sandusky Biological Station, Sandusky, Ohio	Research on heavy metals in Lake Erie fishes, age and growth studies on walleye. Fish population assessment in Lake Ontario.
Tunison Laboratory of Fish Nutrition Cortland, N.Y.	Research on Atlantic salmon and lake trout toward development of improved diets for production of better fish.
Western Fish Disease Laboratory Seattle, Wash.	Research on nature and prevention of communicable diseases in western salmon and trout.

Table 7–2.—Federal laboratories conducting research related to marine science and engineering (continued)

Department or agency facility and location	Function
DEPARTMENT OF THE INTERIOR (DOI)	
Fish and Wildlife Service (FWS)	
Great Lakes Fishery Laboratory Ann Arbor, Mich.	Research to delineate physical and biological parameters of Great Lakes, including fish population dynamics.
Southeastern Fish Control Laboratory Warm Springs, Ga.	Develop analytical methods for determining residues of fish control agents in fish. Toxicity studies on lamprey larvicide TFM.
Hammond Bay Biological Station, Millersburg, Mich.	Research on sea lamprey control, utilizing both chemical and biological methods.
Western Fish Nutrition Laboratory Cook, Wash.	Research on nutritional needs of western salmon and trout.
Abernathy Salmon Culture Development Center, Longview, Wash.	Develop improved method of culturing fish (primary emphasis on Pacific salmon).
U.S. Geological Survey (USGS)	
National Center, Reston, Va.	Performs surveys, investigations, and research covering topography, geology, and mineral and water resources of the United States.
Geologic Division, Office of Marine Geology, Reston, Va.	Investigations of marine geological resources and environment.
Branch of Atlantic – Gulf of Mexico Marine Geology, Quissett Campus, Woods Hole Oceanographic Institution, Woods Hole, Mass.	Investigations of the geological resources and environments of the Atlantic continental shelf.
Field Office, Corpus Christi, Tex.	Investigations of the geological resources and environments of the Gulf of Mexico continental shelf.
Branch of Pacific – Arctic Marine Geology, Menlo Park, Calif.	Investigations of the geological resources anad environments of the Pacific and Arctic continental shelf.
Conservation Division, Reston, Va.	Classification and evaluation of mineral resource potentials of offshore Federal lands. Supervision of offshore mineral development and extraction operations on leased Federal lands.
Eastern Region, Washington, D.C.	Classification and evaluation of mineral resource potentials of Atlantic offshore Federal lands. Supervision of Atlantic offshore mineral development and extraction operations on leased Federal lands.
Gulf of Mexico Region, Metarie, La.	Classification and evaluation of mineral resource potentials of Gulf of Mexico offshore Federal lands. Supervision of Gulf of Mexico offshore mineral development and extraction operations on leased Federal lands.
Western Region, Menlo Park, Calif.	Classification and evaluation of mineral resource potentials of Pacific offshore Federal lands. Supervision of Pacific offshore mineral development and extraction operations on leased Federal lands.
DEPARTMENT OF TRANSPORTATION (DOT)	
U.S. Coast Guard (USCG)	
Research and Development Center Groton, Conn.	Research and development, test and evaluation of techniques, equipment, systems and materials in support of Coast Guard operational missions.
Fire Test Facility, Mobile, Ala.	Test and evaluate commercial and recreational boating safety equipment and methodology.

Table 7–2.—Federal laboratories conducting research related to marine science and engineering (continued)

Department or agency facility and location	Function
DEPARTMENT OF ENERGY (DOE)	
Knolls Atomic Power Laboratory Schenectady, N.Y.	Performs engineering, research and development work related to design, improvement and operation of nuclear power plants suitable for naval vessels.
Brookhaven National Laboratory Upton, N.Y.	Research in the physical and biological sciences and engineering.
Lawrence Livermore Laboratory Livermore, Calif.	Fundamental and applied research and development related to nuclear sciences and use of atomic energy.
Hollifield National Laboratory Oak Ridge, Tenn.	Conducts an interrelated program in nuclear medical research.
Pacific Northwest Laboratory Richland, Wash.	Energy technology, materials research and development, physical sciences, life sciences, environmental research and nuclear weapons development.
Savannah River Laboratory Aiken, S.C.	Research and development in support of present and future Savannah River products.
Argonne National Laboratory Argonne, Ill.	Applied and basic aspects of nuclear research.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)	
Goddard Space Flight Center Greenbelt, Md.	Development and demonstration of applications of visible, infrared, and passive microwave aerospace remote sensing technology to sea ice, living marine resources, and coastal zone processes monitoring.
Jet Propulsion Laboratory Pasadena, Calif.	Development and demonstration of applications of active microwave aerospace remote sensing technology to measurements of sea state conditions and sea ice.
Langley Research Center, Hampton, Va.	Research and development of multispectral visible aerospace remote sensing technology for applications to surveys of living marine resources and the quality of the coastal water environment.
Lewis Research Center, Cleveland, Ohio	Demonstration of, and transfer of active microwave aerospace ice cover remote sensing technology to Federal agencies for operational use in obtaining ice conditions in the Great Lakes and Alaska coastal waters.
National Space Technology Laboratories Earth Resources Laboratory, Bay St. Louis, Miss.	Demonstrate to, and train other agency personnel in the use of multispectral visible and infrared aerospace remote sensing technology for coastal zone land utilization and wetlands mapping.
Wallops Flight Center, Wallops Island, Va.	Development and demonstration of applications of aerospace radar altimeter technology to mapping of ocean surface topography and measurements of sea state conditions.

leading universities and perform research in oceanography, limnology, meteorology, upper atmosphere and space physics, and remote sensing of the atmosphere and ocean. In-house activities are supplemented by research sponsored through contracts and grants.

At the request of the NOAA Administrator, the Ocean Sciences Board of the National Academy of Sciences reviewed NOAA's R&D program. From May 1975 to May 1976, review teams were sent to a number of NOAA laboratories. These teams evaluated the quality of research done by NOAA laboratories and assessed the effectiveness of the laboratories in terms of equipment, facilities, personnel, management, and quality of research. The academy report, released in late 1977, included analyses of the strengths and weaknesses of each laboratory visited and recommendations to improve their effectiveness.[11]

[11] National Academy of Sciences. *The Quality of NOAA's Ocean Research and Development Programs—An Evaluation.* Washington, D.C., 1977.

The Board found a great deal of variability among the laboratories. The research, for example, at the larger fishery laboratories was largely of excellent quality whereas the quality of the research at some of the small fishery laboratories was disappointing, often as a result of isolation from other scientists doing similar work. The quality of research at ERL laboratories was generally good-to-excellent by comparison with the rest of the ocean science community. However, the Board concluded the application of ocean science results to operational programs within NOAA could be improved. The Board also found that, at some ERL and other nonfishery laboratories, ties with universities and other oceanographic institutions were frequently deficient and that the quality of some of the research at several laboratories suffered because the efforts of researchers were spread too thinly to be effective. NOAA is now considering the recommendations of the Ocean Sciences Board.

Laboratories of Other Ocean-Related Agencies

Although NOAA operates the greatest number of laboratories, most of the other agencies involved in marine science and technology maintain in-house laboratories as well (table 7–2). After NOAA, the agencies operating the most laboratories involved in maritime R&D are the Navy, NASA, the Department of Energy, and the U.S. Fish and Wildlife Service (FWS) of the Department of the Interior. FWS laboratories are committed to research on Great Lakes ecology, coastal ecosystems, and the culture and ecology of Atlantic and Pacific salmon and other anadromous fish. The Department of Energy has eight contractor-operated laboratories in research and development relating to energy technology and nuclear research.

In cooperative ventures with other Federal agencies having major ocean programs, NASA supports the conduct of marine-related research activities at several of its Field Centers. This work is directed to the development, testing, and demonstration of aerospace remote sensing technology applications and to the acquisition of information on dynamic ocean processes and phenomena.

Navy in-house laboratories have a variety of research, development, test, and evaluation projects to improve materials, equipment, techniques, and operational engineering and weapons systems needed in naval operations. Much of the Navy's R&D is dedicated to acoustical research or engineering development of seafloor facilities, submersibles, and man-in-the-sea technology.

University-Related Laboratories

To capitalize on the mutual benefits that can accrue from cooperation between the Government and academic institutions, the Environmental Protection Agency is required, by statute, to establish laboratories near universities with research programs. Other mission agencies have also located in-house facilities in the vicinity of or in conjunction with university programs to encourage the infusion of academic talent and resources into their problem-oriented marine science programs. The Stratton Commission noted that this trend often works to the benefit of both the Federal and the academic laboratories and suggested that the trend should be encouraged.[12]

All of the mission agencies support university research to supplement the work of their in-house laboratories. Most of these contract studies are problem-oriented, although discipline-oriented research is funded by some agencies in scientific areas relevant to their missions. The National Science Foundation, the Navy, NOAA, and the Department of Energy support the largest discipline-oriented programs.

A wide variety of large and small State and private universities participate in Federally-supported marine science programs. Some 100 colleges and universities offer graduate programs in the marine sciences, ocean engineering, or closely related subjects.[13] Most, if not all, of these institutions are involved in marine research, but many of their programs are of modest scale.

The Stratton Commission, in reviewing the progress of the marine sciences, noted the outstanding contributions of a few large oceanographic laboratories. This preeminence was attributed to the multidisciplinary nature of ocean science investigations, which require broad institutional support to research in distant waters and rely on sophisticated and complex facilities. The Commission concluded that a small number of geographically distributed, large marine science centers was needed. It recommended that these centers be established and equipped with the facilities necessary for global and regional marine research programs and that they be "assured of adequate institutional funding for continuity and maintenance of both programs and facilities." [14]

Although not on the scale envisioned by the Stratton Commission, a type of institutional funding of marine science laboratories for deep-ocean research is provided by NSF and the Navy through their ship support programs. The amounts received by institutions, however, are closely tied to the ship requirements of research projects funded by these agencies. Additional university support, part of it institutional, is provided by the NOAA Sea Grant Program.[15]

[12] *Our Nation and The Sea*, op.cit. note 6, p. 29.

[13] U.S. Interagency Committee on Marine Science and Engineering of the Federal Council for Science and Technology. *University Curricula in the Marine Sciences and Related Fields—Academic Years: 1975–1976, 1976–1977*. Doc/Kaufman DeBell Printing, Inc., Syracuse, N.Y., 1975.

[14] *Our Nation and the Sea*, op.cit., note 6, p. 27.

[15] National Sea Grant College and Programs Act, 33 U.S.C. 1121–1124.

Over 150 institutions are engaged in some 700 different Sea Grant projects. Many of these institutions, however, are involved in Sea Grant-supported socioeconomic and legal research (maritime affairs) or in marine education and training projects. Thus, not all of them participate in marine science research.

Twelve universities, university systems, or consortiums have been designated "Sea Grant Colleges." In addition, 18 university programs have been designated "Institutional Programs;" and 10 have been designated "Coherent Programs," as distinguished from single project support. Institutions that do receive institutional support have strong interdisciplinary research programs and offer regional advisory services to transfer information and technology to users. They cooperate in areas of mutual interest with other universities; Federal, State, and local government agencies; and with private industry. Sea Grant Colleges are chosen on the basis of the quality and productivity of their programs in research, education/training, and marine advisory services. Sea Grant College status entitles these institutions to a large degree of autonomy in developing and managing their programs.

Among the Stratton Commission recommendations was one for the establishment of coastal zone laboratories to conduct research and advise States on coastal zone management. The Sea Grant Program was to provide institutional support to these laboratories.[16] Although not in the form proposed, Sea Grant has implemented the Commission's recommendations. The Sea Grant program has assumed major responsibility for the funding of coastal zone research and has made contributions to the knowledge of coastal regions. In 1976, the legislation for the Sea Grant College Program was significantly altered by the removal of the statutory prohibition against contributing to ship support costs with Sea Grant funds and by establishing fellowships and national and international programs.

The Oceanographic Fleet

Marine science and technology is limited by the ability of scientists and engineers to work on the surface, in the water column, and on the seafloor. Therefore, surface vessels, submersibles, buoys, aircraft, and satellites are as necessary for the advancement of ocean science as particle accelerators and research reactors are to particle physics.

The U.S. National Advisory Committee for Oceans and Atmosphere (NACOA), in its 1973 report, observed that the oceanographic fleet had been reduced by 25 percent over the years as a result of budget reductions for ship support. It cautioned then that "underinvestment in the capital structure needed for marine . . . research of the next decade could mean losing ground which could be costly to regain in later years." [17] As a result, the then Secretary of Commerce, Frederick Dent, requested the Federal Council for Science and Technology (FCST) to undertake a study of the capital structure available for marine science.

The study was performed under contract by the Center for Naval Analysis (CNA) and sponsored by the agencies participating in the Interagency Committee on Marine Science and Engineering. Based on 5-year projected needs of the ocean-related agencies, CNA considered four classes of capital assets: (1) ships, (2) aircraft, (3) submersibles/habitats, and (4) high-capacity computers. The major focus of the study, however, was on the oceanographic fleet.

CNA analyzed the adequacy of investment during the 1975–79 fiscal years by using agency 5-year program projections as the basis for determining requirements. Projections for available assets were based on current inventory and agency plans for future procurements and retirements. The study found that there would be a shortfall in shipdays-at-sea under several different assumptions about future inventories and requirements. However, the number of shipdays-at-sea would be adequate if requirements remained constant and retirements from the ship inventory were limited to those planned at the time of the study.[18]

The Interagency Committee on Marine Science and Engineering (ICMSE), in its comments on the study, noted that fleet inadequacies could become serious in the 1980s, as aging ships are dropped from the inventory, and that a renewed shipbuilding program in fiscal year 1978 or later would not remedy the situation in the early 1980s because of the lead times required. Agencies would then have to lease more ship-time or convert existing hulls to ocean science purposes. Neither of these steps result in ships as well suited for ocean science as those specially designed for that purpose, although leased ships may be appropriate to fill the needs of many short-duration programs.

ICMSE also commented that both short- and long-term projections suggested that the greatest need for new ships would be for small, light-displacement vessels for use in basic and mission-oriented research as well as environmental monitoring in coastal waters.[19] The projections cited by ICMSE, are ap-

[16] H.R. 8470, 90th Congress, 1st Session (1967); H.R. 17590, 91st Congress, 2d Session (1970); H.R. 9492, 92d Congress, 1st Session (1971).

[17] U.S. National Advisory Committee for Oceans and Atmosphere, Annual Report: 1973, Washington, D.C., Government Printing Office, 1974, p. 3.

[18] U.S. Interagency Committee on Marine Science and Engineering of the Federal Council for Science and Technology. *The Capital Structures for Ocean Science.* Arlington, Va., Center for Naval Analyses, 1975, p. v.

[19] Ibid., Appendix A to forwarding letter for ICMSE Chairman to FCST Chairman.

parently being fulfilled. In 1977, NACOA observed, with regard to the academic fleet, that "Federal funds for mission-oriented research, largely within a few hundred miles of the U.S. Coast, have grown much more rapidly than those for more basic research on the high seas and in distant waters." [20] NACOA stated that this, and other trends, "have already caused an occasional surplus of available time on the larger research vessels and an increasing demand for the smaller vessels better suited for research in coastal waters." [21] CNA, in 1974, also found underutilization of some ships, ascribed at that time to a lack of operating funds rather than a lack of requirements.

As a result of the declining support for basic research on the high seas, there has recently been a "heavy use of academic ships by the Bureau of Land Management and other mission-oriented Federal agencies and their contractors." [21a] This type of activity, however, is generally of short duration and when the requirements for such work diminish, or new more specialized vessels are brought into service to accomplish mission agency objectives, the underutilization of the larger ships will become more severe. Although a successor program to the International Decade of Ocean Exploration may generate limited, new demand for the larger research vessels, there is little indication of significantly higher requirements for their use in the 1980s.

The relative strength of the United States oceanographic capability compared to other maritime nations such as the Soviet Union is another indicator of United States research capacity. U.S. superiority in terms of oceanographic vessels was overwhelming in the 1950s and early 1960s. By 1971, the United States had 39 research vessels of over 1,000 tons; the USSR had 70 such ships. Counting all Federal and non-Federal oceanographic vessels, including small coastal ships, the United States had 120 ships with a displacement of 180,000 tons and the Soviet Union had 200 with an aggregate displacement of 320,000 tons in 1974. These comparisons, however, mean little in terms of research quality and adequacy to meet current requirements. U.S. ships spend more time at sea and are better equipped than those of the Soviet oceanographic fleet.[22]

A major problem in the maintenance of the fleet from 1974 to the present has been the rapid rise of operating costs. From 1975 to 1977, there was a net reduction of five ships, partly as a result of insufficient increases in funds available to meet rapidly inflating operating costs. The shortage of operating funds was especially severe in 1976, but improved somewhat in 1977.

Nonetheless, the age of the U.S. fleet (table 7–3) remains a matter of serious concern. Forty-four of the 71 ships—over 60 percent—are more than 10 years old, and 16 of them are over 20 years old. The impact of the fall-off in the construction of new ships since the 1960s is illustrated by the fact that, of the 28 ships built in the last 10 years (11 of them in the academic fleet), only 5 (all academic vessels) are less than 5 years old.

Maintaining the material condition of this fleet will, according to NACOA, require sizeable expenditures in the years ahead. For example, major refits of five university vessels, aged 12 to 15 years, are projected to cost $5 to 6 million over the next 5 years. Upgrading the scientific capability of the fleet will require additional expenditures.[23]

University National Oceanographic Laboratory System

In recommending the establishment of university national laboratories, the Stratton Commission suggested that Federal guidelines for their operation include formal provisions for making the facilities of the laboratories available to outside investigators, and for exchanging advice and assistance with other institutions.[24] With this recommendation before it, and in recognition of the need for better use of existing ships and facilities in the face of rising costs, the National Science Foundation and the Navy encouraged the formation of the University National Oceanographic Laboratory System (UNOLS) in 1971 to foster the cooperative use of ships and facilities by marine science institutions.

UNOLS' membership consists of institutions and laboratories that operate or use Federally supported national facilities, including research vessels. The organization includes an advisory council made up of both operators and users to assure that effective use is made of Federally supported facilities and that scientists from all academic institutions have access to them. The advisory council also evaluates the need for new ships and facilities, and for the replacement of outmoded ones and determines whether research resources exceed current needs. The Research Vessel Operator's Council, consisting of marine engineering personnel from ship-operating institutions, works to exchange ship operating and technical information among members, and addresses questions of shipboard engineering, inspection, and safety. The UNOLS staff, located at Woods Hole

[20] U.S. National Advisory Committee on Oceans and Atmosphere. Annual Report No. 6. Washington, D.C., Government Printing Office, 1977, p. 48.

[21] Ibid.

[21a] Ibid, p. 46.

[22] U.S. Congress, Senate, Committee on Commerce. Soviet Oceans Development. 94th Congress, 2d session, Washington, D.C., Government Printing Office, 1976, p. 546; See also Mark W. Janis and Donald C. F. Daniel, The U.S.S.R.: Ocean Use and Ocean Law. *Law Sea Inst. Occasional Paper* No. 21, Kingston, R.I., University of Rhode Island, 1974, p. 6.

[23] NACOA, op.cit. note 20, p. 47.

[24] *Our Nation and The Sea*, op.cit. note 6, p 27.

Table 7–3.—Federal oceanographic fleet

A. Federally supported oceanographic fleet by operator

Operating agency	Number of ships
Academic	28
National Oceanic and Atmospheric Administration	23
U.S. Navy	12
Department of Energy	3
National Science Foundation	1
U.S. Coast Guard	2
U.S. Geological Survey	2
Total:	71

B. Academic fleet

Operating institution	Ship	Year built
University of Alaska	*Acona*	1961
Scripps Institution of Oceanography	*Alpha Helix*	1965
Scripps Institution of Oceanography	*Thomas Washington*	1965
Scripps Institution of Oceanography	*E. B. Scripps*	1965
Scripps Institution of Oceanography	*G. W. Melville*	1970
Lamont Doherty Geological Observatory	*Robert D. Conrad*	1962
Lamont Doherty Geological Observatory	*Vema*	1923
Duke University	*Eastward*	1964
University of Georgia	*Blue Fin*	1972
University of Hawaii	*Kana Keoki*	1967
University of Hawaii	*Moana Wave*	1973
Johns Hopkins University	*Ridgeley Warfield*	1967
Johns Hopkins University	*Maury*	1950
University of Miami	*James M. Gilliss*	1962
University of Miami	*Columbus Iselin*	1972
University of Miami	*Calanus*	1970
Oregon State University	*Wecoma*	1975
Oregon State University	*Cayuse*	1968
University of Rhode Island	*Endeavor*	1976
University of Southern California	*Velero IV*	1948
Texas A&M University	*Gyre*	1973
University of Texas	*Longhorn*	1970
University of Washington	*Thomas G. Thompson*	1965
University of Washington	*Hoh*	1943
University of Washington	*Onar*	1954
Woods Hole Oceanographic Institution	*Knorr*	1969
Woods Hole Oceanographic Institution	*Oceanus*	1975
Woods Hole Oceanographic Institution	*Atlantis II*	1963

[1] Includes only those ships with predominantly Federal funding.

Oceanographic Institution, is jointly funded by the National Science foundation, the Office of Naval Research, the Department of the Interior (USGS and BLM), National Oceanic and Atmospheric Administration, the Department of Energy, and the Environmental Protection Agency.

UNOLS has been concerned mainly with coordinating the scheduling and utilization of university research ships. This task includes the scheduling and use of the research ship, *Alpha Helix,* and the submersible, *Alvin,* both of which have been designated National Oceanographic Facilities. *Alvin* is supported by a tripartite agreement among NSF, Navy, and NOAA. UNOLS has also reviewed the need for ship design studies and uniform cost accounting in ship operations, drafted a long-range plan for university ships, prepared a report on research vessel safety standards, sponsored a study of marine insurance and risk planning, and generally kept its members informed on matters of concern to them. A major part of the UNOLS function is to coordinate the preparation and publication of reports on annual university ship operating schedules. These reports include information on operational areas, studies to be made during the cruises, names of the chief scientists, and ports of call. The schedules are updated several times each year to assist in the use of University-operated oceanographic vessels by informing potential users of scheduled cruises that might have space for add-on experiments.

Underwater Habitats and Submersibles

The Stratton Commission made a number of recommendations for deep ocean exploration and the establishment of seafloor laboratories and facilities. It recommended sponsorship of a program "to develop and construct exploration submersibles with ocean transit capabilities for civil missions to 20,000-foot depths." [25] The Commission also proposed a Navy/NOAA study "of the feasibility of mobile undersea laboratories and large stable ocean platforms which would be used in conjunction with fixed ocean stations." [26]

The Commission Panel on Marine Engineering and Technology recommended the development of three types of undersea laboratories: one, fixed; one portable; and the third, mobile. The mobile undersea support laboratory would provide services to the fixed and portable laboratories and would supplement their functions. It would consist of a nuclear-powered submersible, operating to 1,000-foot water depths and transporting submersible modules to the laboratories for docking.[27] Preliminary planning for the International Decade of Ocean Exploration (IDOE) similarly called for the development of a shallow (1,000 ft) support submarine with its own laboratories and diving systems.[28]

Although the Stratton Commission's ambitious proposals for continental shelf laboratories and submersible development were not implemented, NOAA has purchased a habitat and is studying specifications for a mobile underwater laboratory.

In 1971 NOAA's Manned Undersea Science and Technology Office (MUS&T) was established to support NOAA's activities in manned underwater operations. Since that time, the MUS&T office, which was incorporated into the Office of Ocean Engineering in 1976, has been responsible for the administration of NOAA's undersea habitat program.

Habitat and Diving Activities

The most active habitat project has been the Bahama bank research program performed in HYDROLAB by the Perry Foundation under a MUS&T contract. The HYDROLAB facility is capable of accommodating three to four divers in 100 feet of water through an umbilical life support system connected to an unmanned surface support vessel.[29]

HYDROLAB operated at a depth of 45 feet moored 1 mile offshore at Freeport, Grand Bahama Island, Bahamas, from 1972 through April 1975. It performed almost 20 missions during that period and logged 1,602 man-days of saturated diving, almost all under MUS&T sponsorship. These missions have included diverse studies in the ecology and environmental characteristics of coral reefs. In late 1977, NOAA bought HYDROLAB. The MUS&T office is soliciting scientific proposals for its use.

The MUS&T office has also used the PRINUL (Puerto Rico International Undersea Laboratory) facility, "La Chalupa," for underwater research in Puerto Rico. PRINUL is designed to operate in up to 100 feet and accommodate four divers, supported, as in the HYDROLAB, by a self-contained utility buoy.

PRINUL performed nine missions between November 1972 and May 1974 in water depths ranging from 60 to 100 feet and logged 700 man-day saturated dives of which 504 were sponsored by MUS&T. Projects included ecological and environmental studies, including assessments of fish food resources, fish behavior, engineering investigations on water jet insertion of seafloor anchors and testing of vertical excursion tables, and physiological studies of divers.

In 1975, the German habitat HELGOLAND, was transported to the United States and used by German, Polish and U.S. divers at a depth of about 105 feet off the coast of Massachusetts. None of the three operational U.S. habitats—AEGIR, HYDROLAB, PRINUL—was considered capable of operating in the harsh underwater environment off New England.

In late 1975, in response to a Congressional request, the MUS&T office prepared a concept paper for the development and use of an American mobile, underwater laboratory called OCEANLAB. Funds were appropriated for the project in fiscal year 1977 and a systems program definition contract was awarded to the General Electric Company to develop system configuration requirements and specifications.

The OCEANLAB concept conforms closely to the recommendations of the Stratton Commission for a mobile underwater facility that can function as a manned engineering and science laboratory at various depths and locations.

To develop the specifications for OCEANLAB MUS&T is seeking input from the scientific diving community. An operational diving program is being planned by MUS&T to ensure that the proposed facility will be used for productive marine science and technology in an experimental science program.

Submersible Technology [30]

The experimental development of submersibles, mobile undersea vehicles, began in the 1950s and continued through the early 1960s. Interest in deep

[25] *Our Nation and The Sea*, op.cit. note 6, p. 32.

[26] Ibid., p. 178.

[27] Panel Reports of the Commission on Marine Science, Engineering, and Resources. Volume 2, Industry and Technology—Keys to Oceanic Development, Part VI, Report of the Panel on Marine Engineering and Technology. Washington, D.C., Government Printing Office, 1969, pp. VI-224-229.

[28] National Research Council. *An Oceanic Quest*. Washington, D.C., National Academy of Sciences, 1969, p. 94.

[29] U.S. National Oceanic and Atmospheric Administration, *Manned Undersea Science and Technology Fiscal Year 1974 Report*. Washington, D.C., Government Printing Office, 1975.

[30] Excerpted in part from, U.S. Congress, Senate, Committee on Commerce. Congress and the Oceans: Marine Affairs in the 94th Congress, 95th Congress, 1st Session. Washington, D.C., Government Printing Office, 1977, p. 263 at seq.

submergence technology intensified with the tragic loss of the nuclear submarine *Thresher* in April 1963. The Navy's inability to deal effectively with deepsea search and rescue in the instance of the *Thresher* resulted in reappraisal of the Navy's undersea programs. As a result, the deep submergence system review group recommended development of deep submergence rescue vessels (DSRV), deep submergence search vehicles (DSSV), and deep ocean survey vessels (DOSV). In June 1964, the Navy's deep submergence system project was initiated. Under this project, two DSRVs were constructed, a man-in-the-sea program produced the technology for saturation diving, and a deep ocean salvage program was initiated to develop the technology to cover objectives from depths. Concurrently, independent Navy engineering programs were involved in submersible development, which resulted in a number of vehicles coming on line in subsequent years.

An additional boost was given to submersible technology development in 1966 when a midair collision over the coast of Spain resulted in the loss of an undetonated H-bomb in 2,000 to 3,000 feet of water. Three manned submersibles were deployed for the search. *Alvin* discovered the projectile at 2,800 feet and the Navy unmanned vehicle, *CURV* (controlled underwater research vehicle) was deployed for the recovery. The investment decision to accelerate development of submersibles after the *Thresher* incident was credited as making the successful recovery of the bomb possible.[31]

Industry saw an investment potential for commercial and military use of submersibles in the middle 1960s and responded to the market with updates of earlier prototypes. Interest in submersible development continued to expand in the late 1960s, and a number of new submersibles were launched in 1967–68. In 1969, the Navy advanced submersible technology significantly with the launching of the *NR–1*, using nuclear power, which provided virtually unlimited range.

Overcapitalization in submersibles, extraordinarily high operating expenses, and reductions in the Navy R&D budget after 1968 ended the period of accelerated growth in submersible technology,[32] In 1970, the Navy's own submersibles met most of its needs for such vehicles. The consequent lack of Navy submersible leasing significantly undercut the market for industry-owned research submersibles. As a consequence smaller, more economical vehicles appeared: *Neckton Beta* and *Gamma,* which leased for $1,000/day, replaced vehicles requiring $6,000 to $14,000/day.

The Navy received delivery on the first deep submergence rescue vehicle *(DSRV–1)* in 1970, and what was originally to be a 12 DSRV fleet under the post-*Thresher* plans, stabilized at 2 vehicles with the delivery of the *DSRV–2* in 1971. The recommendations to build OSSVs and DOSVs were never implemented because of projected high costs and the lack of supportable requirement.

The Navy, however, continues to have a major interest in manned undersea operations. As the first Federal agency to develop an interest in the use of submersibles, the Navy remains today as the principal Federal owner and operator of these vehicles (table 7–4). As noted earlier, the Navy submersible, *Alvin,* operated by the Woods Hole Oceanographic Institution, is considered a national oceanographic facility and is available for scientific investigation through UNOLS.

The vehicles built in the early 1970s were designed for shallow dives at 1,000- to 2,000-foot depths. Most were built for foreign customers, and most of them (13 out of 20) were fabricated overseas. The foreign market was spurred by the needs of the oil companies to develop the North Sea Continental Shelf. Large American companies, once the leaders in submersible technology, have all but stopped construction; and unleased, commercial vehicles have been drydocked for lack of market potential. The Federal Government now has only a modest leasing program for scientific and environmental research through NOAA's Manned Undersea Science and Technology (MUS&T) program. [33]

The present U.S. submersible fleet has 30 vehicles. Of these, perhaps only one-half perform missions during any single year.[34] Despite the prospects for increased oil and gas activity on the Outer Continental Shelf, there is little indication that submersible use will increase significantly in the near future.

Ocean Engineering and Technology Development

Federal ocean engineering and technology programs encompass a wide gamut of activities as diverse as the missions of the sponsoring agencies. While these efforts include basic technology development, they are largely directed to specific short-term objectives, rather than laying the basis for meeting long-term ocean engineering requirements.

The importance of general purpose technology was recognized by the Stratton Commission,[35] which

[31] R. Frank Busby. *Manned Submersibles.* Washington, D.C., Government Printing Office, 1976, p. 52.
[32] Ibid., p. 58.
[33] U.S. National Oceanic and Atmospheric Administration. *Manned Undersea Science and Technology Fiscal Year 1975 Report,* Washington, D.C., Government Printing Office, 1976.
[34] Ibid.
[35] *Our Nation and The Sea,* op.cit. note 6, p. 31.

Table 7–4.—Specifications of U.S. submersible vehicles—1976 [a]

Vehicle	Operator	Depth	Crew	Length beam	Weight	Payload
		ft		*ft*	*lb*	*lb*
Sea Ranger	Verne Engineering, Inc.	600	4	17.8	19,000	2,200
Nemo	Southwest Research Institute	600	2	6.6	2,000	850
PC–3B	International Underwater Contractors	600	2	22.4	6,350	1,000
Sea Explorer	Sea Line Inc.	600	2	15.5	3,600	300
PRV–2 [b]	Pierce Subs Inc.	600	3	19.8	15,500	1,000
Margenaut	Margen International	600	8	44.9	108,000	6,000
Nekton Alpha	General Oceanographics	1,000	2	15.4	4,500	300
Nekton Beta	General Oceanographics	1,000	2	15.4	4,700	460
Nekton Gamma	General Oceanographics	1,000	2	15.4	4,700	460
Johnson Sea-Link [b]	Harbor Branch Foundation	1,000	4	23.8	21,000	1,200
Snooper	Undersea Graphics	1,000	2	15.4	4,500	200
Guppy	Sun Shipbuilding & DryDock	1,000	2	11.8	5,000	400
OPSUB	Ocean Systems	1,000	2	18.8	10,400	400
Sea Ray	Sub. R&D Corp.	1,000	2	20.5	9,000	350
Mermaid II	International Underwater Contractors	1,000	2	17.6	14,000	1,000
Nemo I	Seaborne Ventures	1,000	3	12.8	20,000	1,200
Diaphus	Martech International	1,200	2	13.5	10,000	225
PC–14C–2	Kentron, Hawaii	1,200	2	13.5	10,000	225
Star II	Deepwater Explorations, Ltd.	1,200	2	17.5	10,000	500
PC–17 [b c]	Perry Oceanographics, Inc.	1,500	4	34.8	38,000	500
Deep View	Southwest Research Institute	1,500	2	16.6	12,000	500
Johnson Sea-Link [b]	Harbor Branch Foundation	2,000	4	23.8	21,000	1,200
Beaver MK IV [b]	International Underwater Contractors	2,700	5	25.8	34,000	2,000
DSRV–1	U.S. Navy	5,000	4	50.8	75,000	4,300
DSRV–2	U.S. Navy	5,000	4	50.8	75,000	4,300
Sea Cliff	U.S. Navy	6,500	3	26.12	42,000	700
Turtle	U.S. Navy	6,500	3	26.12	42,000	700
Deep Quest	Lockheed Ocean Systems	8,000	4	40.16	115,000	7,000
Alvin	Woods Hole Oceanographic Institution	12,000	3	23.8	32,000	1,500
Trieste II	U.S. Navy	20,000	3	78.19	180,000	2,000

[a] Source: NOAA. *International Status and Utilization of Undersea Vehicles 1976* (1976). [b] Diver lockout. [c] Construction.

recommended that the proposed National Oceanic and Atmospheric Agency "initiate a dynamic and comprehensive fundamental technology program." [36] General purpose technology has also been the subject of recommendations by the Marine Board of the National Academy of Engineering and NACOA. In 1972 the Marine Board recommended that "any organizational arrangement established for marine affairs in the U.S. Government should insure that all long-range engineering development is accorded adequate budgetary priority, continuity, and stability without separating the effort from its professional tie with the interests of mission-related marine activity." [37]

While emphasizing that long-range, engineering development undertaken by the Federal Government should be able to meet its own requirements as a user of technology, the Board suggested that the Government should also support high-risk engineering development for use by the private sector in meeting broad national needs.

In 1974, the National Advisory Committee on Oceans and Atmosphere (NACOA) proposed the establishment of an "Institute for Engineering Research in the Oceans" within NOAA. The purpose of the Institute was: [38]

> ". . . to stimulate and support engineering research (advanced development) in the oceans to meet civilian needs by using seed-money to get good work started, but not supported indefinitely . . . It would be to support work and act as a catalyst in any new areas of special materials and techniques which would serve a multiplicity of marine activities. It would have a central responsibility for improving professional communications and encourage the development of standards."

In September 1976, NOAA established the Office of Ocean Engineering (OOE). Its mission is to exercise functional review over, and recommend policy plans for, NOAA's ocean engineering and instrumentation programs; conduct an integrated program

[36] Ibid., p. 37.

[37] National Academy of Engineering. *Toward Fulfillment of a National Ocean Commitment*. Washington, D.C., National Academy of Sciences, 1972, p. 9.

[38] U.S. National Advisory Committee on Oceans and Atmosphere. *Engineering in the Ocean*. Washington, D.C., Government Printing Office, 1974, p. 3.

of research, technology development, and services related to ocean engineering and undersea operations; and serve as a national focal point for knowledge, a catalyst for industrial development, and a mechanism for technology transfer, relative to civil ocean engineering. OOE originally reported directly to the NOAA Administrator, but, under a recent reorganization, OOE, Sea Grant, ERL, and a newly-created Office of Climate Research report to an Assistant Administrator for R&D.

Although the formation of the Office of Ocean Engineering in NOAA appears to be in accord with the recommendations of the Stratton Commission, the NAE/Marine Board, and NACOA, it does not have the resources needed to provide the central focus for civil ocean engineering recommended by these groups. Even within NOAA itself, OOE is not yet providing a comprehensive engineering service. The Office does not have the responsibility for providing engineering and instrumentation services for NOAA scientific or environmental monitoring activities, and provides minimal services to investigators outside NOAA. At present, more than 95 percent of the resources of OOE are committed to established programs which were transferred to NOAA under Reorganization Plan No. 4: instrumentation, data buoy program, manned underwater support, and, most recently OCEANLAB.

In its Sixth Annual Report, NACOA observed that NOAA's Office of Ocean Engineering has potential for evolving into a leader for ocean engineering among the nondefense Federal agencies and private groups. NACOA recommended that the Secretary of Commerce foster and selectively support programs within industry, the universities, and the Federal agencies to: [39]

- identify and correct deficiencies in civil ocean engineering and technology;
- assure the availability of technical data needed by the ocean engineering community;
- develop technical ocean engineering criteria and material assessments and standards for use by industry and the Federal Government; and
- encourage the cross-utilization of military and civil engineering laboratories and facilities.

The question of its potential for leadership in general-purpose technology aside, NOAA is only one among a number of agencies involved in ocean technology programs oriented to meet mission requirements. The Navy program is the largest and most diversified of these efforts. *The Navy Technical Facility Capability Register,* published in 1973 by the Navy Material Command, indicates an investment of over $260 million by the Navy in laboratory facilities for ocean engineering and related technology programs. These facilities include deep ocean simulation and pressure test chambers, material testing laboratories, test model facilities, pier facilities, hydrodynamic shock simulators, and fluid phenomena laboratories. The diversity of the Navy ocean engineering program can be inferred from the list of ocean engineering facilities at Navy laboratories (table 7–2). Although the Navy program is directed to the development of weapons and systems in support of Naval operations, its unclassified developments can often be applied in the civil sector.

One of the engineering recommendations of the Stratton Commission was for the "construction of high pressure test facilities for testing equipment (and) biomedical pressure chambers for testing and evaluating man in undersea work . . ." [40] The Navy's new Ocean Simulation Facility, at the Naval Coastal Systems Laboratory in Panama City, Florida, implements the Commission's recommendation for a test facility. Housing the world's largest hyperbaric chamber complex, the facility is certified for testing and evaluating diver and equipment performance to a depth equivalent of 2,250 feet of seawater. Nearly all environmental conditions found in the ocean can be simulated under laboratory control at the facility. It serves as a national center available to Government, academic, and industrial laboratories for research, development, testing, and evaluation of systems and hardware used by divers in the ocean environment. A complementary facility used in medical research relevant to diving is the Navy Environmental Health Effects Laboratory in Bethesda, Maryland. This laboratory also has hyperbaric chambers used to assess conditions hazardous to divers.

The engineering aspects of NASA's Ocean Applications Program largely evolve around the development and use of remote sensing systems to observe ocean phenomena from aircraft and Earth-orbiting spacecraft. The Geodynamics Experimental Ocean Satellite (GEOS-3), launched in 1975, has successfully demonstrated the global acquisition of ocean geoidal data and techniques for measuring sea state. SEASAT-A, to be launched in 1978, will be in a near polar orbit and will carry an array of customized remote sensors to scan the oceans. These sensors will measure average wave height and sea-surface temperature, and provide information on windspeed and direction over the ocean surface, ice cover, and cloud cover. The SEASAT-A program, and use of data from the program, is being undertaken as a joint effort involving NOAA and the Navy.

Two Federal agencies, the Department of Commerce's Maritime Administration (MarAd) and the Department of Energy (DOE), have ocean technol-

[39] U.S. National Advisory Committee on Oceans and Atmosphere. *Sixth Annual Report to the President and the Congress.* Washington, D.C., Government Printing Office, 1977, p. 43.

[40] *Our Nation and The Sea,* op.cit. note 6, p. 38.

ogy programs directed to commercial development. MarAd's program is designed to develop advanced technology to rebuild the U.S. merchant fleet so that it can compete effectively with foreign shipping interests. The program is designed to address the total spectrum of industry's technology needs pertaining to both ship construction and operation—over the short, medium, and long term. The primary emphasis of the program, however, is on short-term projects likely to pay off within 5 years.

A unique function of MarAd's R&D program is that industry, the ultimate user of the technology, participates on a cost-sharing basis in the technology development. The current R&D program supports a 10-year merchant marine expansion plan inaugurated in 1970. In the first 5 years of the program, 760 R&D projects were initiated at a cost of $189 million. The maritime industry contributed $62.3 million of these costs, almost one-third of the total.

MarAd's R&D program is organized in two major development areas: advanced ship development and advanced ship operations. Advanced ship development includes projects to improve ship design and shipyard operations as a means of increasing the efficiency and competitiveness of ship construction. Other ship development projects aim at producing more efficient powerplants and other advanced ship machinery. One phase of this work is directed to the development of second-generation, high-powered nuclear engines feasible for use in the commercial fleet.

The advanced ship operations program is concentrated in three major areas. The first is the development of a computerized shipping operation information system to facilitate ship management by making information readily available to reduce shoreside costs and permitting ship operators to monitor container movement and ship availability. The second is the improvement of ship automation systems and equipment for handling cargo more efficiently and safely. The third is the development of advanced communication and navigation systems with the ultimate objective of making global fleet management operations possible.

In support of these two major programs, MarAd funds marine science research to obtain information needed for engineering development and makes technology studies designed to reduce energy consumption in shipping and to prevent pollution from maritime operations.

The Department of Energy's ocean thermal energy conversion (OTEC) program provides an excellent example of high-risk, high-cost development for commercial application undertaken by the Federal Government to meet national needs. The OTEC project was initiated by NSF in 1972 and transferred to ERDA (now incorporated into DOE) in 1975. OTEC is an attempt to use solar energy, stored in ocean waters; specifically, the project is aimed at using temperature differences between near-surface and deep ocean waters to generate electrical power. Present plans call for the demonstration of a commercial prototype system by 1984.

The OTEC concept calls for warm surface water to be pumped through a heat exchanger-evaporator and expelled to the sea. A working fluid would be vaporized in the heat exchanger by the heat of the ocean surface water. The vaporization would drive a turbine coupled to an electrical generator. Reliquefaction of the working fluid would occur in a heat exchanger-condensor where the vapor would be cooled by the temperature of cold deep-ocean water. The working fluid would then be recirculated.

The DOE approach includes technology development, assessment of the effect of the environment on materials used in the powerplant, and the impact of the powerplant on the environment. Additional studies are directed to analyzing the potential market for OTEC applications.

A number of component designs have been developed, and some equipment has been tested for use in an OTEC plant. However, a number of critical problems must be solved, especially in the development of heat exchangers and the prevention of biofouling, which can significantly affect the performance of the heat exchangers. To solve these problems, successive generations of heat exchangers are being developed for testing to evaluate performance and ability to withstand the effects of biofouling and corrosion.

A panel of the Marine Board of the National Academy of Sciences undertook a review of the project for ERDA in 1976. It concluded that "OTEC is technologically feasible with the investment of considerable financial and technological resources." The review panel found, however, that the estimated costs of the project were overoptimistic. Among its recommendations were that "prototype production and tests should be deemphasized in favor of increased basic experimental and developmental work" and that the program "be reoriented to emphasize assessment of the various basic system and subsystem alternatives."

The ocean engineering program of the U.S. Army Corps of Engineers is categorically different from the engineering programs described above. Whereas those programs address problems in observing or making use of the oceans, the Corps' program consists of coastal engineering for the improvement of coastal waterways and harbors and the protection of beaches and seashores. The larger Corps studies are multidisciplinary, encompassing the physical, biological, and sometimes social sciences as well as engineering development.

Engineering projects are based on studies of existing conditions at the sites of small-craft harbors and

deepwater ports, in estuaries and channels, and along seashore areas threatened by erosion. The influence and effectiveness of shore structures or other coastal engineering construction are then assessed in terms of local shore processes. The data gathered in this work are used in engineering and design studies for the planning of navigation, flood control, and shore protection projects. These and other data are also used in evaluating the impact of construction in U.S. navigable waters prior to issuing construction permits.

Each of the Corps' engineering studies is Congressionally mandated. Project studies are performed by Corps of Engineers' district offices, while supporting coastal engineering research is conducted at the Coastal Engineering Research Center in Washington, D.C., and at a number of universities. Other Corps facilities are used in studies entailing the use of models of estuaries and other shore areas. With two exceptions, these models are at the Waterways Experiment Station in Vicksburg, Miss. The exceptions are the San Francisco Bay model in California and the Chesapeake Bay model on Kent Island, Md. The most ambitious model project is the 9-acre Chesapeake Bay hydraulic model, constructed for studies of tidal elevation, salinity, current speed and direction, sedimentation, and temperature. Hydrodynamic studies at this facility are useful in environmental quality assessment as well as for navigational and other purposes.

Under Section 404 of Public Law 92–500, the Corps of Engineers is responsible for granting permits for dredge and fill activities, including the disposal of dredge spoil. This subject is treated in greater detail in chapter IV.

In addition to the Corps of Engineers, two other Federal agencies with regulatory responsibilities support ocean technology programs to assist them in their regulatory missions. The mission of the U.S. Geological Survey (USGS) includes the regulation of OCS oil and gas operations. To facilitate inspection procedures required by this function, USGS has initiated a new contract research and development program involving universities, private industry, and Government laboratories to provide improved technology for detecting problems in offshore oil production systems. The program includes studies relating to the detection of incipient cracks in offshore structures and leaks in offshore pipelines. It also includes a project concerned with the development of an unmanned, free-swimming, inspection vehicle.

The U.S. Coast Guard also supports an active program in marine science and engineering in order to be able to fulfill its peacetime responsibilities for search and rescue, marine environmental protection, aids to navigation, icebreaking, merchant vessel and recreational boating safety, marine law enforcement, port security, and licensing and regulating the construction and operation of deepwater ports. During any given year, the Coast Guard has about 100 research and development projects underway targeted towards solving immediate problems facing the maritime community or towards upgrading the maritime infrastructure of the Nation, including the regulatory functions associated therewith. Particularly noteworthy at this time are research and development efforts directed towards improving vessel traffic services, reducing hazards created by the transport of hazardous cargoes in congested waters, enhancing safety practices and plaftform designs for offshore drilling operations, assisting commercial traffic through ice-infested rivers and lakes, and the prevention, detection, control and cleanup of oil spills. About 20 percent of each year's Coast Guard Academy graduating class of 200-plus cadets have majored in marine science or ocean engineering. Their skills are used to achieve the Coast Guard's multimission responsibilities.

Technology and Information Transfer

An important factor in the effectiveness of ocean programs is the transfer of information and technology from one Federal agency to other Federal agencies, State and local governments, and industry for application. Government-industry transfer, however, is a two-way street, especially where industry develops technology under government contract. In many countries difficulties in government-industry transfer of technology have been minimized by nationalization of industrial enterprises or by the extensive participation of government in furthering industrial and commercial developments. This latter situation is especially notable in Japan.

In the United States, such cooperative interaction is rare, but two examples are found in the area of ocean technology: the Maritime Administration R&D program and the Department of Energy OTEC project. In addition to these efforts, the Freedom of Information Act ensures that Government-developed technology is made available to the private sector and that the Federal agencies involved in technology development are active in promoting the transfer of information and technology to non-Federal interests.

The Navy has been a leader in developing processes for transferring technology to the outside. Navy-developed technology was made available to civil agencies and to non-Federal users on an ad hoc basis until 1972. In February 1972, Navy technology transfer policy was formalized when the Secretary of the Navy issued an instruction on "Military-Civilian Technology Transfer and Cooperative Development." [41]

[41] SECNAVINST 5700.15 (February 28, 1972).

> "It is the policy of the Department of the Navy to promote military-civilian technology transfer and cooperative development on a systematic basis. It will encompass (1) transfer of technology developed by the Department of the Navy for national defense purposes to the civilian sector where such technology can be profitably utilized in nonmilitary applications, and (2) identification of coming technologies in both military and civilian interest and exploration of feasibility from cooperative funding and/or development of such technologies."

In March 1972, the Chief of Navy Material was assigned responsibility "for the execution of military civilian technology transfer and cooperative development matters." [42] A Director of Military-Civilian Technology Transfer and Cooperative Development was designated by the Chief of Navy Material to administer the program under the guidance of the Assistant Secretary of the Navy (R&D).

Coincident with these developments, 11 Department of Defense (DOD) laboratories had been meeting informally to coordinate their efforts in the transfer of military-related technology to civilian users. In June 1972, these efforts resulted in the establishment of the Technology Transfer Laboratory Consortium, authorized by the Deputy Secretary of Defense, "for the purpose of coordinating interaction with other Federal agencies and technology users in Federal, State and local levels, and coordinating civil-sector work being performed for others." [43]

In 1974, this group was expanded to include other Federal agencies and was renamed the Federal Laboratory Consortium for Technology Transfer. At this time, the National Science Foundation assumed the task of coordinating Consortium activities with DOD support. Currently, the Consortium has a membership representing 74 Federal laboratories, both DOD and civil. While the work of the Consortium is not confined to the transfer of marine technology, the transfer of Navy ocean-engineering and marine technology development is facilitated by the Consortium. Members of the Constorium act as "technology brokers" by bringing together groups that have a problem or need with those who have already solved it or are working in pertinent areas. These activities are especially useful to local governments that are frequently unaware of the assistance they might receive from Federal laboratories. The Consortium publishes a variety of pamphlets and other material on its activities.

In addition to its membership in the Consortium, the Navy operates a widespread information system, maintains direct communication between researchers and users, and prepares exhibits and demonstrations to make its technology known. Fifteen Navy handbooks on various aspects of ocean technology have been issued for public distribution. There are still problems, however, involving the transfer of classified material relating to ocean technology. These problems have been the topic of Navy and NOAA discussion and will be considered on an individual basis.

DOD requires that all scientific and technical work by defense agencies and contractors be reported to the Defense Documentation Center (DDC). Unclassified and declassified reports (not subject to other distribution limitations) deriving from this work are regularly transferred to the National Technical Information Service (NTIS) of the Department of Commerce, where they are available to all agencies and to the general public. Classified planning documents or those which are "for official use only" are placed only in the DDC system where some degree of control can be maintained, but where interested agencies, industry, or individuals can have access in accordance with their "need to know." Many of the civil agencies similarly require that their work products be distributed routinely through the Department of Commerce NTIS system.

The Departments of Commerce and Energy, NASA, and other civil agencies are also active in the transfer of technology. The Maritime Administration program, with its industry participation (see above), is a major conduit for technology transfer. The entire purpose of MarAd R&D is to produce technology for industry use. In addition to the formal transfer of technology between MarAd and industry, MarAd's Maritime Research Information Service (MRIS) provides comprehensive information on maritime R&D. The MRIS is a system for the acquisition, selection, storage, retrieval, and dissemination of references on proposed, ongoing, or completed R&D. The system also processes technical reports and journal articles and provides abstracts on request.

In NOAA, the Sea Grant Program maintains an advisory service at each Sea Grant college to provide information to users in the coastal region and in the fishing industry. The National Marine Fisheries Service (NMFS) is responsible for providing technological support to the fishing industry. The Office of Ocean Engineering is developing technology transfer processes for the dissemination of information on ocean instrumentation, diving technology, and other aspects of ocean engineering. OOE also is working with the Navy to make unclassified information contained in classified Navy reports available for civil use, and with DOE in the development of OTEC. Other

[42] OPNAVINST 5700.12 (March 17, 1972).

[43] Operating Policy of the Department of Defense Technology Transfer Laboratory Consortium (June 21, 1972).

NOAA elements, particularly the Environmental Data Service, are similarly active in technology and information transfer.

The Department of Energy's OTEC program, like the MarAd R&D program, is directed entirely to providing industry with new technology. In addition to the technology development itself, however, OTEC includes studies to identify marketable applications of OTEC. Legal, institutional, and political analyses of OTEC utilization are also underway. This work is designed to maximize the potential for commercial application of OTEC technology.

NASA has made technology transfer a major component of its SEASAT Program. The program has been planned in collaboration with other Federal agencies, the National Academy of Sciences, the National Academy of Engineering, and coastal-oriented industries. The program seeks to evaluate the scientific benefits and commercial utility of ocean satellite data, and to transfer remote-sensing technology to the user community. NOAA and the Navy will process SEASAT-A data for their own use and distribute data to other Government and nongovernment users.

Laboratories of both DOE and NASA are members of the Federal Laboratory Consortium. Consortium membership also includes laboratories of the U.S. Geological Survey, Army Corps of Engineers, U.S. Coast Guard, and Environmental Protection Agency.

Marine Research Programs

Federally supported marine science activities, as noted earlier, are performed at Federal agency laboratories and at academic institutions. Most basic and applied marine research performed by non-Federal research institutions is sponsored by four agencies: the National Science Foundation (NSF); the Office of Naval Research (ONR); Department of Energy; and the Department of Commerce's National Oceanic and Atmospheric Administration.

The basic ocean research program of NSF provides the broadest support for academic marine science and is the major supporter of university research. ONR and the Department of Energy sponsor multipurpose research in areas related to their missions. The Sea Grant Program in NOAA supports a broad spectrum of ocean-related research performed by academic institutions.

National Science Foundation

NSF issued its first grant for ocean research in 1951, only a year after the agency came into being. The NSF marine research program grew rapidly and through the 1960s was second only to that of ONR. In 1970, with the inauguration of the International Decade of Ocean Exploration (IDOE), the NSF marine research budget, for the first time, exceeded ONR's.

NSF support of basic marine research is based on proposals from members of the oceanographic research community. Specialists from appropriate fields of science critically evaluate these proposals, in peer-panel reviews, for scientific merit, feasibility, and potential for advancing fundamental knowledge about some feature of the marine environment. Although about 100 academic institutions support research and education in some aspect of the marine sciences, the high cost of operating research ships, submersibles, and other special facilities like piers and self-contained laboratory vans, has resulted in the concentration of a significant part of the research effort at some 15 major coastal laboratories (table 7–2). The research community's size and concentration in these locations accounts for the fact that well over three-fourths of NSF-sponsored oceanographic research is done by scientists at these major laboratories.

The NSF program is administered primarily through the programs of its Division of Ocean Sciences and Division of Earth Sciences, in the Directorate for Astronomical, Atmospheric, Earth, and Ocean Sciences. On a lesser scale, marine research is also supported in the Division of Polar Programs, and Division of Atmospheric Sciences. In addition to this work the Directorate for Biological, Behavioral, and Social Sciences supports a few small marine biology studies and the Directorate for Research Applications has been involved in estuarine studies and research on the feasibility of offshore, multipurpose structures.

Division of Ocean Sciences

In the Division of Ocean Sciences, a basic research program supports projects of individual scientists at the oceanographic institutions; a second supports a limited number of large, managed projects; and a third provides funds for the acquisition and operating costs of the ships and other oceanographic facilities needed to carry out these programs. Support for individual research projects includes more than 300 grants each year. These are made through academic and research institutions, to individual scientists, or to small groups for development of knowledge about the oceans, their resources, and the sea floor. Inves-

tigations concentrate on physical oceanography, marine chemistry, submarine geology and geophysics, and biological oceanography. To support its research program, NSF, in recent years, has become the major direct source of funding for operation of the 29 ships of the academic fleet.

The International Decade of Ocean Exploration (IDOE) supports large-scale, multi-disciplinary projects focused on the role of the oceans in climate, food production, pollution, energy, and natural resources, with multi-national participation in some of the projects. Funding of the IDOE has, from its inception, remained below $20 million per year—far short of the $100 million recommended by the National Academy of Sciences—National Academy of Engineering. It should be acknowledged, however, that IDOE is not the sole international oceanographic program in operation. Others include the International Geodynamics Project, International Phase of Ocean Drilling (IPOD), Circum-Pacific Map Project, and the Global Atmospheric Research Program (GARP). International participation in IDOE has not always been as strong as it might have been; however, NACOA, in its midterm review of the program, noted that the IDOE made a systematic effort to "develop truly international projects." [44]

The four-area format outlined in *An Oceanic Quest* has continued to guide the U.S.—IDOE: (1) environmental quality, (2) environmental forecasting, (3) seabed assessment, and (4) living resources.[45]

Efforts in the "Environmental Quality Program" to date have concentrated on the determination of marine pollution baselines (Geochemical Ocean Sections Study—GEOSECS), movement of pollutants in the ocean (Transfer Processes), and biological effects of pollutants (Controlled Ecosystems Pollution Experiment—CEPEX).

The "Environmental Forecasting Program" is aimed at developing interactive, predictive mathematical and physical models of the ocean and atmosphere to improve forecasting atmospheric and ocean behavior. Studies initiated to date include: investigation of mesoscale eddies in the deep ocean (Mid-Ocean Dynamics Experiment—MODE, and subsequently its Russian-American successor—POLYMODE), impact of ocean-atmospheric interactions over the North Pacific on the climate of North and South America (North Pacific Experiment—NORPAX), development of historical climatic information from oceanic data (Climate: Long-range Investigations, Mapping and Prediction—CLIMAP), and the dynamics of the Southern Ocean (International Southern Ocean Studies—ISOS). MODE, POLYMODE, and NORPAX are funded jointly by NSF and ONR.

The objective of the "Seabed Assessment Program" is to compile information about the seabed which will contribute to the exploration, use, and sound management of the seabed resources. Emphasis has been placed on surveys of the continental margins and the processes which occur there, on midocean ridges, and in deep ocean basins. Projects included are: studies of the continental margins of western Africa and eastern South America (South Atlantic Margins) and studies of metalogenesis and plate tectonics, which centered on the Mid-Atlantic plate and the Nazca plate in the eastern South Pacific and determination of the global distribution of manganese nodules.

Projects in the "Living Resource Program" are aimed at understanding the processes governing the distribution and abundance of marine life. This work includes investigation of the physical and biological aspects of coastal upwellings (Coastal Upwelling Ecosystems Analysis—CUEA) and exploration of the role of seagrasses in coastal ecology, their life cycles, and influence on ocean productivity (Seagrass Ecosystem Study—SES).

IDOE has concentrated on processes and the environment of the open ocean rather than diffusing its limited resources on estuarine and coastal systems. Large, integrated projects have been favored, and IDOE has avoided funding small projects which are normally funded by other NSF offices or the mission agencies.

NACOA's appraisal of the 5-year effort of IDOE was generally laudatory in view of the restricted funding of the program. The NACOA panel concluded that: [46]

> "On balance, we believe that the IDOE has successfully addressed serious deficiencies in the present understanding of ocean processes and ocean resources, has fostered interinstitutional cooperation efforts required to tackle these deficiencies, and has done much to generate a spirit of international cooperation in this area where little had existed previously."

Because IDOE is programed to terminate in 1980, NACOA emphasized the importance of supporting "long-term, multi-disciplinary, multi-institutional oceanic studies" and recommended, as one alternative, that NSF may consider an Office of Ocean Exploration to continue the momentum of the Decade. In response to the NACOA recommendation, the NSF Office for the International Decade of Ocean Exploration convened a series of five workshops in 1977 to explore the directions that a continued program may take after 1980. A sixth plenary

[44] U.S. National Advisory Committee on Oceans and Atmosphere. *International Decade of Ocean Exploration.* Washington-ton, D.C., Government Printing Office, 1975, p. 8.

[45] National Research Council. *An Oceanic Quest.* Washington, D.C., National Academy of Sciences, 1969,

[46] NACOA, op.cit. note 44, p. 2.

workshop was convened in 1977 to integrate the plans for continuation of an international research program in the next decade. A sequel to the pre-IDOE planning document, which was compiled by the National Research Council in 1969 (*An Oceanic Quest*), will be released in the summer of 1978.

Division of Earth Sciences

The most prominent NSF marine program outside the Division of Ocean Sciences is the Deepsea Drilling Project (DSDP), part of the NSF Sediment Coring Program of the Earth Sciences Division. Scientific advice and planning are provided by the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES). Nine U.S. and five foreign research institutions are members of JOIDES. Project operations are managed for NSF by the University of California, through the Scripps Institution of Oceanography, which is responsible for accomplishing the project's scientific objectives: determining the composition, structure, and geological history of bottom sediments and upper basement rocks of the world's ocean basins. The University of California subcontracts with Global Marine, Inc., to perform the actual drilling and coring operations using its ship the *Glomar Challenger*. By February 1978, a total of 679 holes at 446 sites had been drilled in all the major deep-water ocean basins and seas of the world.

The fourth phase of the project, the International Phase of Ocean Drilling (IPOD), is being conducted with increased international support. In January 1974, the Soviet Union signed a Memorandum of Understanding with NSF, agreeing to contribute $1 million per year to the project for 5 years. Since the beginning of fiscal year 1976, agreements to contribute $1 million each per year to IPOD were signed by France, the Federal Republic of Germany, Japan, and the United Kingdom.

Division of Atmospheric Sciences

The Division of Atmospheric Sciences participates in interdisciplinary studies of air-sea interaction to determine the influence of the ocean on local weather conditions and on global climate. A major part of this program has consisted of investigations in support of the Global Atmospheric Research Program (GARP). These experiments have included the GARP Atlantic Tropical Experiment, a large-scale, multinational project to assess related oceanic and atmospheric processes in the tropical Atlantic, and the Indian Ocean Experiment, a study of the structure of the circulation in the Western Indian Ocean. A successor to this last project is now in the planning stage. The new project, the Monsoon Experiment, to be conducted in 1978-79, will involve research on the eastward-flowing, equatorial undercurrent.

Division of Polar Programs

The Division of Polar Programs supports ocean science studies in its Antarctic and Arctic research programs. Among these projects is a study, begun in the late 1960s, to assess the northward flow of Antarctic bottom water formed in the Weddell Sea. The Division of Polar Programs has also supported recent research in the Scotia Sea to obtain information about the formation of sea floor features. The Arctic program is analyzing data collected in a 14-month joint U.S. and Canadian study of air-sea interaction in the Arctic Ocean northeast of Point Barrow, Alaska. The objective of the study was to understand how Arctic processes affect climate and to improve techniques of ice forecasting.

The Sea Grant College Program

The Sea Grant Program was established under the National Sea Grant College Program Act passed by the 89th Congress in 1966.[47] The program is patterned on the century-old Land Grant Program, the purpose of which was to provide support to colleges and universities to promote agricultural development. For 4 years, 1966–70, the Sea Grant Program resided in the National Science Foundation. In 1970, it was transferred to the newly formed National Oceanic and Atmospheric Administration by Reorganization Plan No. 4.

The Sea Grant research program is directed toward the development, conservation, and management of ocean and coastal resources. About 41 percent of the $12.94 million allocated in fiscal year 1977 to Sea Grant scientific research focuses on the development of marine resources, 34 percent is directed to marine technology development, and 35 percent to marine environmental research. The Sea Grant research program is not limited to marine science, however. Sea Grant devotes almost $3 million to research in marine socioeconomics and law (marine affairs). Moreover, this research program is supplemented by educational activities and advisory services. Each of these aspects of the Sea Grant Program complements the others. Historically, Federal funds and contracts made available under the Sea Grant program may not exceed two-thirds of the total cost of the project. At least one-third of the cost, therefore, must be paid for in matching funds.

Amendments to the Sea Grant Act, passed in 1976, added an international element to the Sea Grant Program. Under these amendments, grants and contracts may be negotiated with any Sea Grant

[47] National Sea Grant College Program Act, 33 U.S.C. 1121–1124.

college, Seat Grant regional consortium, or any other institution of higher education in the United States, to enhance the research and development capabilities of developing foreign nations, and promote the international exchange of information and data with respect to ocean and coastal resources. This program will encourage the research and development of, and technology transfer to, developing countries. The Congress enacted the amendment to improve scientific cooperation between developing foreign nations, and their institutions of higher education, with those of the United States.

The Sea Grant Program has been innovative in providing institutional support to universities having the capabilities to deal broadly with marine and coastal zone issues and in providing information needed by States, local governments, and the fishing, recreation, offshore oil, and other marine-related industries. Deficiencies in the Sea Grant Program, however, were identified by NACOA in its Sixth Annual Report published in June 1976. One of these was that while Sea Grant has been useful in responding to local and regional needs, its resources were not available to assist in solving broader national and international problems. NACOA also expressed the view that there was often a lack of coordination between Sea Grant programs and other elements of NOAA and other Federal agencies. NACOA raised questions about the Sea Grant advisory and proposal review structures, and it recommended that, in addition to funding increases required to keep pace with inflation, the Sea Grant budget be increased from $23 million in fiscal year 1976 to $40 million within a few years.

Other NOAA Marine Research Programs

The NOAA system of Environmental Research Laboratories and other NOAA elements are involved in a variety of research activities. These projects include studies of coastal and deep-ocean physical, chemical, geological, and biological oceanography. Two major multidisciplinary programs are included in these efforts: the Marine Ecosystems Analysis Program and the Outer Continental Shelf Environmental Assessment Program. Both of these programs are discussed in chapter VI. NOAA fisheries research is discussed in chapter III.

Navy Ocean Science Program

The Navy Ocean Science Program is the oldest Federal program supporting basic marine research at the universities. Throughout the 1950s and much of the 1960s, Navy support of university ocean research exceeded that of NSF. Today, it remains the second largest program supporting university R&D. The goal of the Navy Ocean Science Program is to provide the basis of knowledge needed about the oceans to support the Navy's national defense mission. The Navy has long recognized the value of basic research in areas of Navy interest and the contribution such research can make to the continued improvement of the Navy's defense posture. Consequently, Navy efforts in ocean science contribute not only to the Navy's primary mission, but add to the fund of basic knowledge used to advance toward broad social, economic, and scientific goals.

Navy ocean science responds to long-range requirements determined by the Director for Defense Research and Engineering. University research in the ocean science program is supported primarily by the Office of Naval Research (ONR). The content of the program is reviewed annually and adjusted in accordance with projected Navy requirements. Contracts for research are awarded in response to unsolicited proposals. Such proposals are evaluated on their relevance to Navy needs, scientific quality, the competence of the investigator, and the facilities available for the proposed research. The Ocean Science Program is discipline-oriented and encompasses physical and chemical oceanography, marine ecology and geophysics, oceanic biology, ocean technology (described earlier), and underwater acoustics.

The purpose of the physical oceanography program is to improve the understanding of open-ocean physical processes. This work is of fundamental interest to the scientific community and necessary to environmental prediction needed for a wide variety of civil activities as well as for Naval operations. Physical oceanographers have now identified the major factors affecting oceanic variability such as western boundary currents, mesoscale eddies, and internal waves. The Navy research program is now concentrating on studies of the processes whereby energy enters the ocean, generates ocean variables, and is transferred through the water before being dissipated. An understanding of these processes and of energy transfer rates is essential in progress towards the ability to make accurate oceanic forecasts.

The chemical oceanography program is closely linked to the Navy's fundamental research in oceanic biology, marine geology, and acoustics. Chemical oceanography is concentrated in three general problem areas: (1) assessing processes and mechanisms that govern the inorganic composition of seawater; (2) determining chemical fluxes through the marine environment, including air-sea and sediment-sea exchanges; and (3) gauging the impact of life processes

on the chemistry of the ocean. Currently, studies of the inorganic and physical chemistry of seawater are being deemphasized because of advances made in previous years. Conversely, studies of chemical fluxes are being accelerated to determine the routes and rates of transfer of chemical elements among the major repositories of these elements: the ocean, atmosphere, crystalline rock, Earth mantle, rivers, and sediment. The program is also increasing its emphasis on organic chemical studies to obtain more knowledge of the interrelationships between the chemistry and the biology of the ocean.

The configuration and properties of the ocean floor influence a number of Navy activities including acoustic and nonacoustic submarine and antisubmarine operations; surveillance system design, installation, and maintenance; search and recovery operations; and inertial navigation, guidance, and trajectory calculations. Navy research in marine geology and geophysics is directed to understanding seafloor properties and is concentrated in studies of the processes that control bathymetric, gravity, magnetic, and acoustic variability of the ocean basins. The primary emphasis of this work is on seismic/acoustic studies of the layering, variability, and transmission characteristics of the deep-sea floor. A second major research area is concerned with understanding the sources and location of bathymetric, gravity, and magnetic anomalies. A third program element examines the dynamics of sediment transport.

Navy oceanic biology studies are concerned with the biofouling and deterioration of underwater equipment and structures, protection of swimming and diving operations, and acoustics. This program encompasses research in biochemistry, physiology, ecology, behavior, taxonomy, zoogeography, microbiology, and microacoustics.

Navy acoustics studies seek to contribute to undersea surveillance, target localization and detection, and underwater communications. The acoustics program consists of three categories of research. These three categories focus on the effects of the water column, surface, and bottom on acoustic propagation. The current emphasis of the program is on the effects of internal waves, currents, and mesoscale eddies on acoustic signals. In addition to these studies, the acoustics research program relies on the findings of the physical, chemical, geological, and biological programs.

In 1976, the Marine Board of the National Academy of Engineering and the Ocean Sciences Board of the National Academy of Sciences completed a joint study of the Navy's oceanographic program. The emphasis of this study, initiated at the request of the Assistant Secretary of the Navy for Research and Development, was on projected Navy needs in order to provide the basis for planning its future ocean science and engineering programs. In reviewing the recent history of the Navy ocean program, the study noted that the funds expended for basic ocean science research have remained virtually constant since 1965, but owing to inflation, have declined in absolute terms.[48] The Academies attributed the decline to strict measures instituted by Secretary of Defense McNamara "to insure that military research and development would be mission-oriented." The funding for some parts of ONR's research program was cut back in subsequent Navy budgets. This effect was compounded in 1969 after enactment of the Mansfield Amendment to the 1970 Appropriations Act, requiring that all Navy research be relevant to the Navy's mission.[49]

Although the Mansfield Amendment had the effect of law for only 1 year, it has had a lasting impact on naval research programs. The 1971 Appropriations Act required that research have a potential relationship to a military activity as determined by the Secretary of Defense. Since 1971, there have been no legislatively enacted restrictions on Navy research, but the constraints of the 1970 and 1971 Acts have been regarded as guidelines for research.

The steering group noted that "projects dropped from Navy programs as not being mission-oriented, or those appearing to duplicate work in other agencies often would not turn up on other agency programs in a form that could be useful to the Navy."[50] The group noted that the Navy may have too strictly interpreted the term "relevance". It recommended that "mission relevance" be more broadly defined for ocean science and engineering.[51]

[48] National Academy of Sciences. *Directions for Naval Oceanography.* Washington, D.C., 1976, p. 111.
[49] Ibid., p. 110.
[50] Ibid.
[51] Ibid., p. 113

Department of Energy

The marine science program of the Department of Energy (DOE) originates from the Atomic Energy Act of 1954, which established the former Atomic Energy Commission (AEC). AEC was charged with preventing pollution of the sea by radionuclides in amounts that would adversely affect man and the marine resources used by him.

The AEC marine science research program was

directed toward determining those environmental factors that influence the movement of radionuclides through the marine environment, the possible paths and rates of return of radioactivity to man through food webs, and basic ecological processes. Within this broad program were studies on biological, physical, and chemical oceanography, and studies related to operational activities such as the effect of waste heat on local ecosystems at nuclear power stations.

When AEC was divided into the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC) in 1975, its research program was inherited by ERDA. ERDA's marine program became concerned not only with the fate, transport, and effects of radionuclides, but with all energy-derived products, including thermal energy, that might affect the marine environment. In 1977, ERDA was incorporated into DOE. The primary focus of the marine program is now on understanding dynamic systems and processes in order to predict how energy-related activities will affect the environment. The nature of such work is generally long-range since it involves natural, long-term fluctuations in the ecosystem, which must be determined and distinguished from short-term or anomalous events. These studies are important to all energy-related activities in the ocean, whether they involve biomass production, ocean thermal energy conversion, Outer Continental Shelf development, floating or onshore powerplants, petroleum development, or the transportation of energy-related materials.

Other priorities of the DOE marine program are directed toward understanding specific energy-related processes such as hydrocarbon cycling through sediments and biota, the fate of atmospheric trace metal pollutants from combustion sources, the deposition rate of radionuclides, and the effects of powerplant effluent discharges on the ecosystem.

The DOE oil and gas program is developing indices for determining the health of the ecosystem by studying changes in behavior, photosynthesis activity, immune responses, and fertility of marine organisms when subject to chronic and accidental oil release; determining flushing rates and current patterns of shelf areas to know what areas will be affected by petroleum releases and the length of time the pollution conditions will remain in the marine system; evaluating initial and continuing damage and recovery rates of biological systems affected by different-sized spills of crude and refined oil for varying lengths of time; identifying compounds in crude and refined petroleums that are potentially damaging to the ecosystem and determining pathways of chemical and biological transformation of toxic compounds; determining bioavailability of toxic compounds released during petroleum exploration and development by particle absorption, desorption, and suspension in the water column.

DOE supports a program to assess the ecological effects of water-cooling systems for use in ocean thermal energy conversion (OTEC), floating nuclear plants for the generation of electricity, and conventional power plants. This program is directed to the development of validated models permitting quantitative estimates of how cooling systems affect mortalities in representative freshwater, brackish water, and marine populations; the determination of the identity, quantity, and environmental effects of persistent compounds formed through chlorination or other biocide treatment of cooling water and the evaluation of alternatives to chlorination; the development of alternative designs for intake structures to reduce or eliminate the mortalities associated with conventional structures and procedures; and the assessment of the effects of cooling system effluents on organisms.

Another DOE program is aimed at providing environmental, health, and safety data for use in the development of offshore nuclear powerplants and establishing criteria for the safe disposal of high-level radioactive wastes in the ocean. This program focuses on characterizing the processes and mechanisms governing the movement, geochemical behavior, and effects of radionuclides in the marine environment, including their transmission through the food chain. In a complementary project, EPA is studying low- and intermediate-level radioactivity at nuclear waste disposal sites used between 1946 and 1970. (See discussion of EPA program in chapter VI.)

DOE does not conduct inhouse research, per se. The program is based on research contracts to both on-site (the four contractor-operated National Laboratories) and six off-site (primarily university) institutions. To integrate environmental research projects with the activities of other Federal agencies, and with personnel in the field, regional scientific coordinators have been designated for the South Atlantic Bight; the Northeast, particularly the Mid-Atlantic Bight; and the Northwest.

DOE's multidisciplinary programs are organized on a regional basis. The three largest regional projects are: (1) physical and biological studies in the Mid-Atlantic Bight to define movement of water masses, particularly across boundary layers, and their influence on biomass production (Brookhaven National Laboratory); (2) food chain studies in the South California Bight to determine the influence of climate and physical and chemical factors on biomass production (Scripps Institution of Oceanography); and (3) radionuclide cycling in deep and shallow oceanic systems (Woods Hole Oceanographic Institution).

Interagency Coordination of Marine Science and Technology

Government support of marine R&D is predicated on the value of marine science and technology in achieving broad political, economic, social, and cultural goals. Responsibility for the pursuit of these objectives has been assigned to the mission agencies. On the other hand, there are compelling reasons to treat science and technology as a whole in order to provide a mechanism to overview governmental science activities and ensure a balanced, efficient use and development of the nation's intellectual and technological resources. The problem of governmental involvement in science and technology is complicated further by the nature of the R&D process itself. Research and development is a continuous, integrated process, beginning with basic research and extending through applied research and development. Thus, responsibilities among Government agencies, academic institutions, and industry are diffuse. The scientific disciplines do not separate among the agencies to the extent that coordination can be achieved easily. The programs of a single agency often interact with a variety of disciplines and institutions. Furthermore, the dynamics of science itself constantly present new and changing problems to Government.[52]

Federal programs in marine science and technology are pluralistic; a number of agencies may be performing or supporting similar and related tasks relevant to their missions. This pluralism is considered by many as a strength of the system. According to the proponents, diversity in funding and sponsorship ensures that good ideas and pioneering research proposals can find support somewhere in the Federal system. In 1975, however, GAO observed that "it is doubtful that the resources of the 11 departments and agencies are being applied to best serve national purposes." [53] Better coordination among the agencies conducting and sponsoring ocean R&D is frequently called for. To improve coordination, proposals have been made to: (1) consolidate research functions through reorganization, (2) re-establish a governmental entity in the Executive Office of the President similar to the Marine Science Council, or (3) revitalize the interagency coordinating mechanism through the intervention of the Office of Science and Technology Policy (OSTP).

It is difficult to define or detect duplication in areas of Government-sponsored ocean R&D. Scientific and engineering knowledge is developed as a cumulative process. Seldom are major breakthroughs realized in a one-time effort. Some degree of redundancy in national R&D programs is not categorically bad, providing it is known and is part of overall ocean R&D strategy. A greater potential for error exists where lack of coordination results in omissions, lost research opportunities, or inadequate emphasis on specific areas of inquiry.

GAO did not undertake an analysis of agency duplication but it noted that a number of agencies were involved in similar areas of research. Seven departments and agencies were administering 15 programs to assess the structure and composition of the ocean floor. Six supported 14 different programs on marine biology and ecology. Five had nine separate programs to investigate the effects of pollutants on marine ecosystems. In technology development, five departments and agencies were identified as working on at least 13 programs to develop, test, and evaluate oceanographic instruments.[54]

Although GAO's findings imply overlap and duplication, the differences in the sponsoring agencies' mission requirements must be considered. Commenting on the GAO report, several agencies noted that the programs cited by GAO in each of the four categories were conducted for agency missions that differed in substance and purpose. The Federal Council on Science and Technology noted that many of the activities of the agencies are similar and require comparable experimental facilities. These agencies share available ship time and a common data base by storing the data produced in a central depository, the National Oceanographic Data Center, administered by NOAA's Environmental Data Service. All agencies and many foreign scientists have access to these files.[55] It should be noted that this system also provides U.S. scientists with access to foreign data.

Interagency coordination of marine science and technology depends largely on an informal communication system. The need for a formal review or clearance system among the agencies funding marine science and technology must be determined by further examination. Scientists caution, however, that a formal system of review must be leavened with reason and not be permitted to encumber scientific initiative.

The marine science community has its own peer communication system that encourages coordination at the bench-science level, but this in itself does not address the problems of interagency research administration and the allocation of research resources among the agencies. The scientific community is

[52] Ronald Brickman. "Interagency Coordination in Science Policy: A Comparative Study of Theory and Practice." The American Political Science Association, Sept. 1–4, 1977, Washington, D.C., p. 2.

[53] U.S. General Accounting Office. *The Need for a National Ocean Program and Plan.* Report to the Congress GGD–75–97, 1975, p. i.

[54] Ibid., pp. 17–22.

[55] GAO, op.cit. note 53, p. 65.

chary of any centralization of science funding, or centralized review and approval. This reflects both a concern for the "big brother" image of the Federal Government, which could impose unwanted direction and governmental objectives on academic research through funding restrictions, and a desire to maintain flexibility for "selling" research projects to a multiplicity of agencies with alternative sources of Federal research funds.

Three possible levels of science coordination may be adopted as public policy: (1) *Collegial communication*—where agency representatives and the science community informally exchange information about their respective programs in the absence of a formal review system; (2) *Agency mutuality*—where a formal framework for review of agency R&D through rational and technical criteria operates to avoid duplication, subdivides responsibilities, and integrates mutually supportive efforts and resources; and (3) *Federal planning and direction*—which involves setting Government-wide goals and policy objectives in R&D and structuring programs across agency lines to conform to an overall design.

The coordination of Federal marine science and technology programs has relied upon a combination of "collegial communication" and "agency mutuality," focused through the Interagency Committee on Oceanography before 1966, the Marine Science Council between 1966 and 1971, and the ocean-related interagency committees subsequent to that time. Moreover, as in all Federal programs, coordination occurs in the budget process.

Coordination of agency programs is achieved by agency participation in a number of formal and informal interagency committees and by agreements among agencies on the conduct of cooperative programs. These arrangements have been effective in facilitating the exchange of information about agency programs and providing a basis for cooperative effort. In addition to cooperation in a number of joint projects, agencies collaborate by: (1) sharing ship time and specialized facilities; (2) making data available to other Federal and non-Federal interests through data centers such as NOAA's Environmental Data Service and the Smithsonian Oceanographic Sorting Center; (3) participating in special advisory groups to review each other's program plans, and (4) commenting on research proposals received by other agencies.

The Navy's Office of Naval Research, the National Science Foundation, NOAA's Office of Sea Grant, and the Department of Energy all convene special workshops or review panels of researchers in pertinent fields from other Federal agencies and universities to review their research projects. Formal and informal meetings also are called among the agencies to review progress on existing cooperative research studies and to examine requirements for new ones. Examples of such projects include Bureau of Land Management/Department of Energy studies of the dynamics of petroleum cycling in the oceans, Bureau of Land Management/NOAA environmental assessment studies relevant to Outer Continental Shelf oil development, NOAA/Department of Energy studies on sediment transport, ONR/IDOE research on seafloor assessment and pollutant transfer, ONR/USGS cooperative studies in sediment dynamics, and Coast Guard/NOAA cooperation in the data-buoy program. This last project includes arrangements for the detailing of Coast Guard personnel to data-buoy projects of NOAA's Office of Ocean Engineering. The Coast Guard also provides shore and ship support for the placement, servicing, and maintenance of data buoys.

Other interagency coordination occurs in such forums as the National Advisory Committee on Oceans and Atmosphere (NACOA), the University National Oceanographic Laboratory System (UNOLS), and the Interagency Committee on Marine Science and Engineering (ICMSE). ICMSE consisted of representatives of all of the agencies participating in the Federal Ocean Program. Established in 1971, when the Marine Science Council was terminated, ICMSE reviewed agency programs and occasionally made recommendations to OMB for budget adjustments. Seldom, however, were ICMSE's reviews stringent and critical, and there is little indication that its funding recommendations to OMB had any effect on the marine science budget. ICMSE also participated in a number of studies for the Senate's National Ocean Policy Study and cooperated with GAO on other matters of interest to the Congress. ICMSE's most important role, however, was its function as a forum for the exchange of information among the agencies, thus enabling them to maximize the mutual use of program resources.

The Federal Council for Science and Technology was replaced in 1976 by the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). FCCSET established a new committee, the Committee on Atmosphere and Oceans (CAO), to replace the old FCST committees, ICMSE, and the Interdepartmental Committee on Atmospheric Sciences (ICAS). FCCSET and the Office of Science and Technology Policy (OSTP) were reorganized in 1977. Their functions have only recently been determined within the Executive Office of the President. As a result of the reorganization, CAO has been less active than ICMSE. The interaction between FCCSET and OSTP is unclear, but assuming OSTP support, the CAO may evolve into an effective coordinating mechanism. Even if it does, the need for other formal and informal coordination systems will continue. The need to establish stronger mechanisms will require further appraisal.

Chapter VIII: Marine Employment, Education, and Training

Introduction

Today over 2 million people work in the marine and maritime fields, almost as many as in agriculture. They represent a variety of occupations and, not surprisingly, are trained and educated in a variety of ways.

The degree of Federal involvement in their training varies. Federal aid to universities is crucial in the training of marine scientific and engineering professionals, though this role is limited to financial assistance and does not include direct Federal operation of the schools. Federal programs play a large role in the training of merchant marine officers, though many officers continue to be trained other than through the Government-supported maritime academies. The Federal role in the vocational training of skilled workers and maritime seamen generally is limited to providing financial assistance to States and private schools, which are responsible for the actual training. Several Federal programs deal with marine education for the general public, ranging from curriculum development assistance for elementary and secondary schools to public information and public participation programs for those citizens interested in policy matters.

Overall, the marine and maritime training and education system in this country is decentralized and diverse, with the State, local, and private roles usually larger than that of the Federal Government. Yet, significant Federal involvement has been a natural development, given both the emphasis that Americans attach to all forms of education and the vital importance of trained personnel to the national oceans' effort. Furthermore, while the Federal Government is only one of many governmental and private organizations which are involved in marine education, its funds greatly influence who is trained and for which occupations. Thus, Federal policies affect the entire marine education effort in this country.

There appears to be little political controversy either about the basic Federal role or about national marine personnel and education policies in general. Some specific issues have been raised, but most observers feel that the basic system is functioning satisfactorily and meeting the Nation's marine and maritime personnel needs.

Present and Projected Employment

Total marine and maritime employment was estimated to be slightly over 2 million in 1975 and according to one set of projections is expected to be almost 2.4 million by 1980 (tables 8-1 and 8-2; fig. 8-1).[1] In addition to this civilian workforce, in 1975, the U.S. Navy had 549,000 uniformed personnel, the Coast Guard some 38,000, and the NOAA Corps about 380.

Some basic conclusions can be drawn by comparing the 1975 estimates with those for 1980. A reasonable rate of growth can be expected in all parts of the field, while the largest expansion, in absolute numbers, will occur in the largest employment settings (fig. 8-1). However, these 1980 estimates may be overly optimistic, particularly regarding growth for longshoremen and the ship construction industry. In fact, shipbuilding jobs may decrease sharply after 1978.

Development of the Federal Role

The Federal role in marine and maritime education should be discussed in the context of Federal education policies in general. And those policies are the result of both certain deeply-held beliefs and several important historical developments.

Two beliefs are most important: One is the strong traditional American faith in the value of education. In part, this reflects the view that some Government-sponsored education is needed if the Nation is to have the trained personnel necessary for both na-

[1] Edward F. Mackin and Roger D. Anderson. "Marine Manpower: An Initial Assessment." *Marine Technology Society Journal* 10, May 1976, p. 36. The authors emphasize that these numbers are only estimates, especially the 1980 figures.

Table 8-1.—Marine employment by industry and occupational family 1975 [1]

	Marine Recreation					Marine Science				Marine Resources				Marine Technology			Marine Operations			
	Total	Aquaria and museums	Boat building	Marinas	Sport fishing	Advisory services	Education and training	Regulatory and environmental	Research and development	Aquaculture	Commercial fishing	Mining and petroleum	Seafood processing	Marine construction	Waterway engineering and ocean	Ship building	Merchant marine	Inland operations	Port and harbor	Offshore support
Scientific	27,250	480	310		20	530	7,000	4,790	870	3,460	1,530	2,280	860	260	3,800	630	10	40	150	230
Engineering	44,900	60	3,640	70	50	400	1,500	4,950	5,920	260	1,050	2,460	250	4,840	4,100	12,300	80	1,510	660	800
Technical	46,010	120	2,680	190	150	430	3,000	5,380	4,490	1,750	670	3,650	2,040	4,390	6,080	7,510	70	1,170	840	1,400
Managerial	243,220	2,160	83,530	9,120	14,250	940	500	11,680	780	2,200	19,050	5,550	17,660	25,400	9,250	9,840	1,040	18,490	11,230	450
Communications	8,950	300	430	50	130	2,960	50	910	90			650	300	30	1,050	560	50	1,110	230	40
Supportive	343,070	17,400	69,750	4,750	12,830	5,640	3,950	70,210	5,390	2,070	11,920	6,580	19,420	14,430	10,960	32,210	2,010	35,050	16,090	1,800
Sales	176,680	1,220	105,340	810	16,720	10	50	140	60	240	1,390	160	39,000	600	270	790	40	720	8,900	140
Electrical	33,940	60	3,280	1,140	520	140		1,730	30	30	50	1,110	940	10,660	1,850	10,030	50	1,130	210	970
Filters	93,750	20	20,040	1,440	660	160		2,120	30	30	190	240	1,300	5,470	430	60,250	60	1,000	210	100
Craftsmen	284,280		33,940	17,180	8,800	540	100	6,550	230	1,560	9,050	6,440		92,510	10,740	88,520	280	5,020	2,630	190
Mechanics	157,870	180	55,610	35,340	17,340	630	250	7,790	130	180	1,050	1,990	7,000	5,010	3,320	11,130	220	3,900	6,020	780
Seamen	185,190		370	540	2,090	80	500	990	170	1,940	11,780	2,580	480	4,940	4,300	510	43,900	81,310	6,840	21,870
Longshoremen	107,590		4,740	270	4,050	120		1,530		270	1,630	690	9,640	8,970	1,150	2,140	2,080	6,020	63,870	420
Fishermen	197,420		240	3,050	3,190	420		1,280	1,810	9,010	157,380		21,040							
Laborers	116,880		16,090	4,050	4,200			3,950			8,260	1,620	27,070	34,490	2,700	9,580	90	2,930	1,040	810
TOTAL	2,067,000	22,000	400,000	78,000	85,000	13,000	17,000	124,000	20,000	23,000	225,000	36,000	147,000	212,000	60,000	246,000	50,000	160,000	119,000	30,000

[1] Source: Edward F. Mackin and Roger D. Anderson. Marine Manpower: An Initial Assessment. *Marine Technology Society Journal* 10(4):26–37, May 1976.

Table 8-2.—Marine employment by industry and occupational family 1980 [1]

		Marine Recreation				Marine Science				Marine Resources			Marine Technology				Marine Operations			
	Total	Aquaria and museums	Boat building	Marinas	Sport fishing	Advisory services	Education and training	Regulatory and environmental	Research and development	Aquaculture	Commercial fishing	Mining and petroleum	Seafood processing	Marine construction	Waterway and ocean engineering	Ship building	Merchant marine	Inland operations	Port and harbor	Offshore support
Scientific	30,950	550	340		20	610	7,400	5,560	1,000	3,760	1,700	2,530	880	320	4,940	740	10	50	160	380
Engineering	52,860	70	3,930	80	50	460	1,590	5,750	6,810	280	1,170	2,730	250	5,910	5,330	14,500	90	1,840	690	1,330
Technical	54,110	140	2,890	230	160	500	3,180	6,250	5,160	1,900	740	4,060	2,080	5,360	7,900	8,850	80	1,420	880	2,330
Managerial	273,670	2,450	90,210	11,110	15,090	1,090	640	13,560	900	2,390	21,170	6,170	18,020	31,030	12,020	11,000	1,140	22,530	11,800	750
Communications	10,460	340	460	60	140	3,420	50	1,060	100			720	310	40	1,370	660	70	1,350	240	70
Supportive	390,940	19,770	75,340	5,790	13,580	6,510	4,190	81,520	6,210	2,250	13,240	7,310	19,820	17,630	14,250	37,970	2,210	43,450	16,900	3,000
Sales	188,500	1,390	113,770	990	17,700	10	50	160	70	260	1,540	180	39,790	730	350	930	40	880	9,430	230
Electrical	40,560	70	3,540	1,390	550	160		2,010	30	30	60	1,230	960	13,020	2,400	11,820	70	1,380	220	1,620
Filters	108,570	20	21,640	1,750	700	180		2,460	30	30	210	270	1,330	6,680	560	71,030	70	1,220	220	170
Craftsmen	335,260		36,660	20,920	9,320	620	110	7,610	260	1,700	10,050	7,150		113,020	13,960	104,370	310	6,120	2,760	320
Mechanics	178,740	200	60,060	43,040	18,360	730	260	9,050	150	200	1,170	2,210	7,140	6,120	4,320	13,120	240	4,750	6,320	1,300
Seamen	227,050		400	660	2,210	90	530	1,150	200	2,110	13,090	2,870	490	6,040	5,540	600	48,280	99,100	7,190	36,450
Longshoremen	116,780		5,120	330	4,290	140		1,780		290	1,810	770	9,840	10,960	1,500	2,520	2,290	7,340	67,100	700
Fishermen	217,550		260	3,720	3,380	480		1,490	2,080	9,800	174,870		21,470							
Laborers	133,000		17,380	4,930	4,450			4,590			9,180	1,800	27,620	42,140	3,510	11,290	100	3,570	1,090	1,350
TOTAL	2,359,000	25,000	432,000	95,000	90,000	15,000	18,000	144,000	23,000	25,000	250,000	40,000	150,000	259,000	78,000	290,000	55,000	195,000	125,000	50,000

[1] Source: Edward F. Mackin and Roger D. Anderson, Marine Manpower: An Initial Assessment. *Marine Technology Society Journal* 10(4):26–37, May 1976.

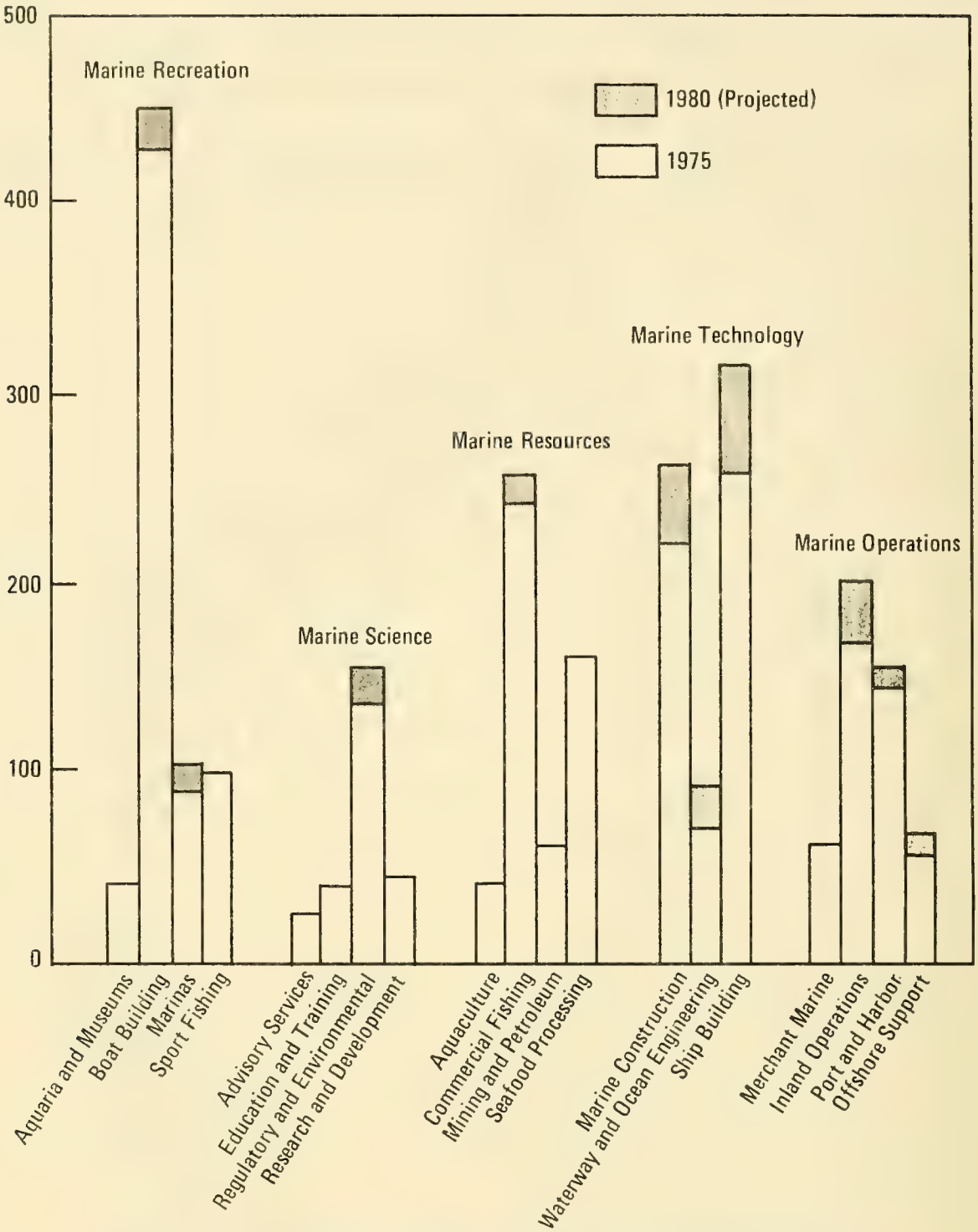


Figure 8-1.—Marine employment by industry in 1975 and projected for 1980. Employment in thousands. Source: Edward F. Mackin and Roger D. Anderson. "Marine Manpower: An Initial Assessment." Marine Technology Society Journal 10(4): 26-37, May 1976.

tional defense and economic development. Trained manpower—marine and otherwise—has seemed particularly important both because of the rapid growth of the country, with the accompanying labor shortages, and because of continuing changes in both military and civilian technology. This belief also reflects the idea, voiced most forcefully by Thomas Jefferson, that widely available education is vital to the development of a free society. Education is seen as the main vehicle for ensuring equal opportunity, as well as one way to produce the informed and "enlightened" citizenry that is seen as vital for a healthy democracy. This idea of an informed and active citizenry is still very much with us, as seen in the recent public participation movement, which is affecting the marine field as well as elsewhere.

Americans thus have long supported the concept of public education.[2] In addition, education policies also have reflected a second strong belief—the principle that public education primarily should be the responsibility of State and local governments and not the Federal. This has been partly for pragmatic reasons, particularly that State and local efforts can meet local needs better than the central Government in Washington, and partly for philosophical reasons based on the idea of federalism—a belief that education should be controlled at the lowest governmental level practical. Yet, there have long been important qualifications to this principle of State and local control, and over the years they have led to a strong Federal role in several parts of this Nation's educational system.

One important early theme was the role of the Federal Government as an employer and often further trainer of the professionals needed to staff the Federal agencies. The new Nation was large, undeveloped, and in many places even unexplored, and from the earliest days of the republic the Federal Government was involved in surveys, public works, and other activities related to national development.[3]

The Coast and Geodetic Survey (now the National Ocean Survey within NOAA) was the first important such agency in the marine field. As early as 1795, the Third Congress found that large sections of the Atlantic Coast were inadequately surveyed. After further debate, the Coast and Geodetic Survey was created by the Ninth Congress in 1807. The National Ocean Survey continues to hire and help train marine scientists and other professionals.[4]

Then, in 1871, President Grant signed a bill establishing an Office of Commissioner of Fish and Fisheries, creating an important source of employment and further training for early fisheries specialists. In 1885, the Commissioner established his headquarters at Woods Hole, Mass., creating the nucleus for a center of marine research and education.[5]

A second aspect of the Federal role in education goes back to the beginning of the 19th century and the need for trained military officers. Since national defense was a Federal responsibility under the Constitution, President Jefferson was able to persuade Congress, in 1802, to establish a United States Military Academy at West Point. This was the first time that Federal funds were used in direct support of higher education. The Naval Academy was established in 1845, and the Coast Guard Academy in 1876, confirming a national policy for training a sea-going officer Corps. Later naval reserve officer training programs were started at civilian colleges and universities.

The research and training done by armed forces and their academies helped meet civilian as well as military needs. Among other things, West Point was the Nation's first engineering school, and in 1824 the Army Civil Works Program was established for river and harbor projects. In the 1830s a young naval officer, Matthew Maury, made pioneering studies of winds, currents, and hydrology while on ocean voyages. In 1842, he was placed in charge of the Depot of Charts and Instruments, out of which grew two important centers of marine study and training, the U.S. Naval Observatory and the Hydrology Office. Today the Navy continues to train marine specialists; many of the people now in the civilian ocean agencies, universities, and private companies at one time or another received training or experience while working with the Navy.

A third major theme of the Federal role in education also developed around 1800—the principle that limited Federal assistance to States and localities is appropriate in certain cases where State resources are lacking. First, the Ordinance of 1787 reserved a plot of land in every prospective township west of the Alleghenies for the support of education, a step that became a precedent for national educational aid. Then, in 1862 the Morrill Act granted public land to every State establishing a public agricultural college. While the aim was to support agriculture and mechanics, the Act not only set a precedent for Federal support of civilian higher education, but also provided the model for the Sea Grant Program of a century later.[6]

---

[2] *Encyclopedia Britannica*, 1974 edition. "Education, History of," by Adolphe E. Meyer and others. Macropedia 6: 365–367, 381–383.

[3] See chapter V, Marine Transportation, for a discussion of early Federal involvement in the development of the Nation's marine transportation infrastructure.

[4] U.S. Department of Commerce. *Annual Report of the Secretary of Commerce*. Washington, D.C., Government Printing Office, 1976, p. 102.

[5] Ibid., pp. 108–109.

[6] Adolphe E. Meyer and others, op cit. note 2, p. 365.

Federal assistance to State maritime academies began in 1874, initially in the form of Federally supplied ships.

The idea of limited Federal assistance to vocational education was incorporated in the Smith-Lever Act of 1914 and subsequent acts leading up to today's Vocational Education Act of 1963, as amended in 1967 and 1976.

While most of the themes of Federal involvement in education were in place by the early years of the 20th century, it was the First and Second World Wars that modified and extended these ideas and led directly to today's Federal programs.

Maritime officer education was the first area affected. The importance of a strong merchant marine to national defense had long been a major theme of American policy,[7] and the shortage of trained merchant marine officers during and after World War I was considered serious. The result was a 1938 decision to extend the service academy concept and create a national merchant marine academy at Kings Point, N.Y. Later, in 1958, the Federal role was expanded still further with the decision to provide financial assistance to State maritime academies.

Then during World War II the theme of general aid to higher education was expanded dramatically. Rapid changes in military technology and the increasing importance of scientific research on weaponry made military research an important part of the national defense effort. The Nation's civilian universities became a major focus for this research, as well as the main training grounds for the scientists and engineers who performed such work. Large amounts of Federal money began going to universities, though as before, the Federal Government's role was one of financial assistance, not direct operation of the schools. Marine education, like other fields, became highly science oriented, with a heavy orientation toward research for military applications. Today Federal funding of research—and the research assistantships which help support and train many graduate students—is a central feature of American higher education.

In the 1950s and 1960s new programs were added as the Federal Government took on further responsibilities. The creation of the National Science Foundation (NSF) in 1950 reflected a new emphasis on basic research and the training of researchers, both seen as important not only to military innovation, but also to the general advancement of knowledge and economic growth. Today NSF is the Nation's largest single source of funding for basic oceanographic research and associated graduate student education. Then in the 1960s, the space program and health research programs reflected a new emphasis on the value of mission-oriented civilian research. Enacted in 1966, the National Sea Grant College and Program Act established a similar system of support for applied research and education in ocean fields, based on what the Morrill Act did for agriculture. (See chapter VII, Marine Science and Technology.)

By the late 1950s, NSF had expanded its programs to improve science education to the elementary and secondary levels, starting a precedent for Federal assistance in improving precollege curriculum and teaching. Today, the Sea Grant Program and others engage in similar activities to improve precollege marine education.

Finally, the marine area has been affected by the new theme of public participation in Government decisionmaking, a theme which has grown to prominence largely as a result of the environmental movement. Ocean agency programs have gone beyond providing information to seeking new ways to involve the public in policy formulation.

Organization of the Chapter

The following sections will examine these Federal marine and maritime policies for education and employment. U.S. policy on these subjects is divided into four broad categories of Government activity:

(1) Federal policies toward higher education and the training of marine professionals;
(2) maritime officer education;
(3) marine and maritime vocational training; and
(4) Federal activities for educating the public, including precollege marine education as well as public information and public participation programs.

Each section includes a consideration of the background and major justifications for Government involvement, an assessment of current policy, and a description of the present policymaking system. In addition, a brief discussion of some of the major contemporary policy issues in each area is included.

[7] See chapter V, Marine Transportation.

Education and Training of Marine Professionals

Present Federal Policy

Today Federal policy on the training of marine professionals seems guided by three general ideas.[8] First, Federal programs are intended to help ensure that the Nation has the professionals it needs, particularly scientists and engineers to perform research important to national defense and general economic development. Second, the Federal effort has been tailored to fit within the existing, largely decentralized framework of American higher education. It has not been Federal policy to take over the operation of State and private schools or to establish alternative, nonuniversity centers for the training, though some advanced training of professionals is still provided within the Navy, the Coast Guard, and the civilian ocean agenies. Third, a more recent development in the marine fields, as elsewhere, is the new emphasis on training public policy specialists, including marine lawyers, economists, analysts, and planners.

It is important to note that the Federal Government is only one of several groups which determine the Nation's marine education policies. Others include the professional societies of scientists and engineers, State governments, and the universities themselves. However, the Federal role is central, because of the importance of its financial support.

Federal Support

The importance of ensuring adequate numbers of scientific and technical personnel first was articulated in the creation of the Office of Naval Research and later in the National Science Foundation (NSF) Act of 1950. The 1950 Act, among other things, authorized NSF to provide fellowships and training grants to graduate students. A key assumption behind this policy is the presumed connection between trained scientific manpower and the national R&D capability. One of NSF's major responsibilities "is to assure an adequate supply of highly trained young scientists to maintain the strength of the Nation's scientific research capabilities . . ."[9] Research, in turn, has been supported because of the role applied research can play in meeting civilian and defense needs and because of the role basic research plays in laying the groundwork for applied efforts.[10] Most, though not all, Federal assistance to graduate students comes indirectly, in the form of research assistantships rather than direct fellowships or loans.

The Sea Grant College and Program Act of 1966 also mentioned the importance of trained professionals. Section 1121(b) of the Act stated "that it is the national interest of the United States to develop the skilled manpower, including scientists, engineers, and technicians, and the facilities and equipment necessary for the exploitation of these [marine] resources. . . ."

Historically, this emphasis on linking education to research has resulted in young science and engineering professors being trained more as researchers than as teachers, though since 1952 NSF has operated some summer institutes for the advanced training of college teachers.[11] Today the program is known as the NSF Chautauqua-Type Short Courses for College Teachers, conducted by the American Association for the Advancement of Science with support from NSF. In the 1960s, there was concern about the perceived lack of good marine science teachers. For example, in 1969 the staff of the Stratton Commission's Panel on Education, Manpower, and Training observed:[12]

> "In the past, most funds in marine science and technology went into research; not enough have gone into teaching, with the result that the Nation is now short of competent teaching personnel."

But in recent years there has been little discussion of teacher shortages, perhaps because graduate school programs expanded in the late 1960s, producing additional teachers as well as more researchers. Also, over the years the Sea Grant program has improved college-level marine education through its curriculum development efforts.

Role of the Universities

Until the Second World War, almost all Government-sponsored research—and much advanced training associated with it—went on in Government laboratories; to this day large laboratory systems are maintained by the National Oceanic and Atmospheric Administration (NOAA), the Navy, and other Federal agencies ranging from the Department of Agriculture and NASA to the Veterans Administration. Yet, for many years the Government has relied on outside institutions to provide the basic training for

[8] This section discusses scientists, engineers, and policy specialists. Maritime officers, another important group of marine professionals, are discussed in the next section.

[9] U.S. National Science Foundation. *National Science Foundation Annual Report 1975*. Washington, D.C., Government Printing Office, 1975, p. 83.

[10] See chapter VII, Marine Science and Technology.

[11] U.S. Congress, House Committee on Science and Technology. *The National Science Foundation and Pre-College Science Education: 1950–1975*. 94th Congress, 2nd Session, Serial T, Washington, D.C., Government Printing Office, 1976.

[12] Panel Reports of the Commission on Marine Science, Engineering, and Resources, Volume 1, Science and Environment, Part IV, Report of the Panel on Education, Manpower, and Training. Washington, D.C., Government Printing Office, 1969, p. IV–8.

its scientific and technical professionals, a policy reinforced by this century's emphasis on formal higher education and degrees and by the post-World War II use of the universities as large-scale centers for both research and the training of researchers.

The American concept of the university played a major role in this development. American higher education has long been flexible and willing to start new programs. During and after World War II the universities were able to expand their graduate programs to meet the Nation's personnel needs. Furthermore, American universities were well prepared to produce what the Government needed most: researchers. Unlike some other countries, for example France, American universities have long combined research and graduate education in the same institution. This goes back to 1867 and the creation of Johns Hopkins University. Inspired by the scholarly accomplishments of German universities, Hopkins put its emphasis on research, a precedent which greatly influenced the early graduate school programs that were created in the late 19th century.[13]

This emphasis on combining research and education in the same institution has certain implications. One is that many of the Nation's best scientists—the university professors—are not involved in full-time research, because they spend some time teaching. Yet, it is an advantage from the Government's point of view that this also means that young scientists are well trained and active in research while still in school.

The number and types of assistantships supported by the Government's research programs have important implications for professional education. One is that students are trained in those specific areas where funding is available during their graduate years. This is beneficial in the sense that they are prepared for research in areas of interest to the Government and where there may be jobs in the future. Problems result, however, if Government priorities exclude some important area, or if the agencies shift funding priorities rapidly, thus training people in fields where subsequently they may not be employable.

There is concern that some marine areas are being neglected. For instance, in ocean engineering some feel that Federal research programs have funded research and education adequately in certain areas (ship hydrodynamics) and not in others (ship structures and marine propulsion and control systems). Because post-masters degree studies usually can be supported in an academic institution only if the related research is externally funded, these research policies affect education significantly.[14] Federal research policies and priorities continue to influence greatly what kinds of marine professionals are trained in this country.

There is also some concern that an overemphasis on research exists, at the expense of undergraduate teaching.[15]

Some other observers are concerned about the present health of the university-based educational system. Professor Alyn Duxbury of the University of Washington has voiced concern about the lack of standardization in the marine science programs which now exist around the country, especially the fact that there are two kinds of programs. One is essentially based on traditional disciplines, e.g., physics, chemistry, and biology, the other is marine science-oriented, and students from one sometimes have difficulty in applying to the other. He suggests, "that an inter-institution academic group rise to the challenge of bringing order and guidance to those programs of marine science and to establish rules for standardizing course work programs in this field."[16]

In addition, some professors in the marine field share the concern of their colleagues in other fields about the general problems now facing American universities. In particular, they feel that financial support is eroding and beginning to affect building maintenance and laboratories, problems that do not show up immediately but can do harm in the long run. There also is concern that applied research is being overemphasized at the expense of basic work (See Chapter VII, Marine Science and Technology.) These are not strictly issues of Federal policy, because university funding comes from a variety of Federal, State, and private sources. But because Federal research policies play such an important role in university life and education, this concern does raise questions about the adequacy and course of present Federal policy. The marine scientific community is likely to raise this matter in the future.[17]

There are also other implications of relying on universities to provide both research and personnel. One is that while academic departments are often isolated from each other, universities nonetheless offer opportunities both for interdisciplinary research (and the training that goes with it) and for interdisciplinary courses. This point is especially relevant in light of the third, and still developing, policy objective in the field of marine professional training.

Marine Affairs

Growing concern about environmental damage to the oceans and increasing use of the ocean's food, energy, and mineral resources has affected both ocean

[13] Adolphe E. Meyer and others, op. cit. note 2, pp. 366–367.

[14] J. Francis Ogilvie. "Education for the Marine Industry," *Marine Technology Society Journal* 14: 225. July 1977.

[15] Ibid., pp. 225–226.

[16] Alyn C. Duxbury. "Marine Science Education—Some Inequities," in Marine Technology Society and Institute of Electrical and Electronics Engineers, *Oceans '77 Conference Record* 1: 22B–1 to 22B–2.

[17] For a statement of general concerns about the health of U.S. basic research, see National Science Board, *Science at the Bicentennial—A Report from the Research Community*. Washington, D.C., Government Printing Office, 1976. See also P. M. Boffey, *Science*, 22 October 1976, pp. 409–410.

policy in general and marine education in particular. The general effects can be seen in the new legislation on environmental protection and resource management passed during this decade, including the Coastal Zone Management Act of 1972 and the Fishery Conservation and Management Act of 1976.

A parallel result is an emphasis on research and education in "marine affairs." This takes two forms. One is the training of marine lawyers, economists, analysts, planners, and managers who can handle the new tasks of environmental protection and management of marine and coastal resources. The other is to train marine scientists and engineers so they can deal with these new problems which involve policy considerations as well as scientific factors.

The emphasis on training in marine affairs is reflected in the Sea Grant legislation. For instance, the Senate Committee report on the 1976 revision of the Sea Grant Act called for the program to help "equip the United States for leadership in the oceans." [18]

Present Marine Education System

Today, some 160 colleges and universities have programs in marine science, ocean engineering, and related fields.[19]

While it is difficult to get precise enrollment and budget statistics, it is clear that there is now a substantial U.S. network of marine education programs. It is estimated that the number of students enrolled at any given time in marine graduate programs has been over 1,000 for the past two decades.[20]

The marine educational network trains not only American professionals, but also significant numbers of students from abroad, making the United States a leader in world marine education. Twelve schools are now designated as Sea Grant Colleges. While this title is largely honorary and carries no guarantee of continued funding by NOAA's Office of Sea Grant, it does indicate that the Nation now has a series of established marine research and education centers.

In addition to the marine education programs, the marine field also draws upon scientists and engineers trained in the traditional disciplines of biology, engineering, geology, etc. This "transferability" of professionals between the marine and nonmarine fields has important implications. One is that the marine personnel system has considerable flexibility. People can move in and out of the field relatively easily during times of either high marine unemployment or shortages of marine personnel.[21]

Two other factors add to the flexibility of the system. Within certain limits, universities and colleges have the ability to contract, expand, or modify their enrollments as the job potential—and student interest—in a given field rises or falls. Also, if there is a sudden rise in the demand for civilian marine personnel, defense contractors and their skilled marine professionals can be called upon.

The result is that the marine personnel system has strengths that help it keep the supply of professionals balanced with demand. Some observers, noting this, have concluded that the present educational system will be sufficient to meet the needs of any major new ocean efforts. For instance, the Stratton Commission said this in 1969 when discussing manpower needs for its proposed national ocean program: [22]

> "The Commission appreciates that its proposed national effort will require large numbers of well-educated, well-trained people. The majority view among those whom the Commission has consulted on manpower problems is that an exciting, broad-scale marine program will generate its own personnel. The personnel will come principally through transfer from land-based scientific, engineering, and technical specialties, but also through increased enrollments in marine education and training programs.
>
> "The Commission does not imply that support for ocean-related education and training is unnecessary—only that it may be unwise to tailor large new education and training programs to our present limited perception of future needs. Certainly some programs to extend the national capability for production of manpower are required, and such capability should be expanded or created. But, until it is possible to develop a better conception of future manpower needs, care must be taken not to overproduce manpower, particularly in fields in which transfer from land to sea activities is relatively simple."

[18] U.S. Congress, Senate, Sea Grant Improvement Act of 1976, S. Report 94–848 to accompany S. 3165, 94th Congress, 2d session, 1976, p. 4.

[19] U.S. Interagency Committee on Marine Science and Engineering, Federal Council for Science and Technology. *University Curricula in the Marine Sciences and Related Fields: Academic Years 1975–1976, 1976–1977.*

[20] Dale F. Leipper. "Ocean Education: Where Now?" in Marine Technology Society and Institute of Electrical and Electronic Engineers, *Oceans '77 Conference Report* 1: 22D–2.

[21] National Academy of Sciences—National Research Council, Panel on Ocean Science Manpower Data. *Ocean Science Manpower Data and Their Interpretation.* Washington, D.C., 1971, pp. 3–6.

[22] Report of the Commission on Marine Science, Engineering, and Resources to the President of the United States and the U.S. Congress, by Julius A. Stratton, Chairman. *Our Nation and The Sea—A Plan for National Action.* Washington, D.C., Government Printing Office, 1969, p. 44.

The Commission did recommend increased funding for the Sea Grant program and NSF educational activities of that time, but it proposed no new large marine education efforts.

Detailed information on marine manpower supply and demand is lacking (a point to be discussed later), but today there appear to be few complaints about either shortages or surpluses of marine professionals.

Perhaps because of this, there seems to be little major criticism of the present university-based system for educating marine professionals. There is concern about funding, of course, and sometimes about spending priorities, but there are few serious proposals to change either the organization of the universities or the way the Federal Government participates in marine education. One indication of this is that despite the concerns mentioned earlier and despite periodic amendments to existing legislation, this field has had no major new laws since the creation of the Sea Grant program in 1966.

Three Major Federal Programs

Several Federal agencies have higher education programs which affect marine training as well as education in other fields. For instance, the Office of Education in the Department of Health, Education, and Welfare administers the Higher Education Act, which provides fellowships, loans, and other assistance to college students. The Veterans Administration operates the GI-Bill program.

Of the several agencies involved in higher education, historically three have supported the marine field through major Federal programs: The Navy's Office of Naval Research (ONR), the National Science Foundation (NSF), and the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), which now operates the National Sea Grant Program. Also, the Department of Transportation funds a small program for graduate work for Coast Guard officers. Table 8-3 gives estimates of expenditures by these agencies for marine education in recent years (FY 1974, 1975, and 1976). Not included in the table are extensive Navy and NOAA programs of graduate-level education for their personnel. The Department of Commerce figure is for Sea Grant educational activities, which include both research assistantships and efforts to develop college and pre-college curricula. The Department of Defense figure is primarily for research assistantships related to ONR contracts with universities. The NSF figure is for fellowships and training grants to students in the marine sciences; it does not include research assistantships related to NSF grants and contracts.

Table 8-3.—Estimates of expenditures by Federal agencies for marine education in colleges and universities [1]

Estimated by fiscal year:	1974	1975	1976
		million dollars	
Education	10.1	11.3	11.3
Department of Commerce	5.0	5.8	5.8
Department of Defense Military	4.1	4.5	4.6
National Science Foundation [2]	0.7	0.7	0.6
Department of Transportation	0.3	0.3	0.3

[1] Source: Science and Technology Policy Office, National Science Foundation. *The Federal Ocean Program.* Washington, D.C., Government Printing Office. April 1975, p. 87.

[2] NSF figures do not include university research assistantships financed through Foundation grants and contracts.

Office of Naval Research (ONR)

ONR was created to support research—both at universities and within the Navy's own laboratories. However, over the years many graduate students have worked on ONR-sponsored projects, gaining training and experience in the process.

ONR was the first major Government research organization established after World War II. It not only has had an enormous impact on marine science, but also has served as the model for other Federal programs funding university research and development. It provided a timely infusion of money into American postwar science, and gave its university researchers a substantial amount of independence. It was willing to fund basic research and was sensitive enough to scientific norms to allow virtually all of the research it supported to be published in the open scientific literature.[23]

The Navy's role in university research and attendant training was reduced in 1970, however, when the Congress passed the so-called Mansfield Amendment. This directed the military to stop financing any projects or studies in basic science unless they are closely related "to a military function or operation." [24] ONR's mission and budget were sharply cut as a result, and NSF took on the responsibility of being the main Federal sponsor of basic research. Yet ONR continues to fund applied research projects

[23] Daniel Greenberg. *The Politics of Pure Science.* New York and Cleveland, The World Publishing Company, 1967, pp. 134–138.

[24] Milton Lomask. *A Minor Miracle: An Informal History of the National Science Foundation.* Washington, D.C., Government Printing Office, 1975, p. 240. See also Chapter VII, Marine Science and Technology.

at universities—some $26 million worth in fiscal year 1978.[25]

There are no reliable statistics on the number of marine-oriented graduate students who have received part of their training—and financial support as well—by working on ONR-sponsored projects. Nor is there any quantitative information on the degree to which ONR work has helped professors keep up with new developments, a factor which sometimes helps improve teaching and education. While ONR no longer plays the pivotal role it once did, its contribution continues to be significant.

National Science Foundation (NSF)

Created in 1950 as a result of the postwar faith in the value of basic research and a desire for a civilian focus for such work, NSF is assigned the task of improving both science and science education. Managed jointly by a National Science Board and a Director, NSF is now the Nation's major source of basic research support and non-biomedical fellowships and traineeships. In fiscal year 1978 the Foundation will spend about $14.7 million on the fellowship and traineeship programs, supporting about 1,800 graduate and postdoctoral students.[26] There is no "quota" regarding how many of these fellowships go to marine students or indeed to people in any particular field. Yet, historically, less than $1 million a year of this money has gone to students working on marine studies.

NSF research programs, however, are aggregated by the various scientific fields. Marine programs are administered by the Foundation's Office of Astronomical, Atmospheric, Earth and Ocean Sciences. With an estimated fiscal year 1978 budget of $58.9 million, the Office's Ocean Sciences Program is the principal supporter of academic basic oceanographic research, U.S. participation in the International Decade of Ocean Exploration (IDOE), and the Nation's academic research fleet. The general oceanography and IDOE programs supported 298 graduate students in FY 1972, 298 in FY 1973, 326 in FY 1974, 401 in FY 1975, and 389 in FY 1976.[27]

In addition to these programs oriented toward research and graduate training, NSF also operates a program for undergraduate student-originated studies, one for undergraduate participation in university research, and the Chautauqua-type courses for upgrading the teaching skills of college professors. All three programs cover the full range of the sciences and basic engineering, including marine topics.

While the university marine community would like more funding for these marine training and research programs, there appears to be little criticism of how NSF organizes and operates them. To the extent that there are political controversies, they deal with NSF operations in general, such as criticisms of the Foundation's peer-review system for judging and awarding funds.

Sea Grant

The Sea Grant program was created in 1966 by the National Sea Grant College and Program Act (Public Law 89–688), which authorized programs for education, research, and advisory services related to the development of marine resources. The program was created to meet a perceived need for further applied research and education in the marine field. The 1966 Act assigned Sea Grant to NSF, but the program was transferred to the National Oceanic and Atmospheric Administration (NOAA) when NOAA was created in 1970 by Presidential Reorganization Plan No. 4. The basic Sea Grant Act was rewritten and updated by the Sea Grant Program Improvement Act of 1976 (Public Law 94–641).[28]

Sea Grant is a matching funds program, where Federal money is matched by State and private support. It also provides funds to institutions rather than directly to individual researchers, as NSF and most other Federal research agencies do. Schools which have developed as centers of excellence in marine matters can be designated "Sea Grant colleges;" while this designation does not guarantee a school continued funding from the national office, in practice these schools have received relatively steady funding, enabling them to establish stable long-term operations.

During its early years, the program grew steadily both in terms of budget and number of participating institutions. Estimated Federal funds for fiscal year 1978 are $27,767,000 which will provide about 60 percent of the funds for Sea Grant efforts around the country; States and private groups will provide the rest.[29]

To date, 12 institutions have been designated as Sea Grant colleges: Oregon State and Texas A&M universities; the universities of California, Delaware, Hawaii, North Carolina, Rhode Island, Washington,

[25] Telephone conversation with the Office of the Naval Oceanographer, November 18, 1977.

[26] U.S., National Science Foundation, FY 1978 Budget in Brief to the Congress, in U.S. Congress, House, Department of Housing and Urban Development—Independent Agencies Appropriations for 1978, Hearings before subcommittee of Committee on Appropriations, 95th Congress, 1st session, 1977, part 1, pp. 813–814.

[27] Personal communication with Lauriston R. King, NSF, November 23, 1977.

[28] U.S. Department of Commerce, NOAA. *Sea Grant Annual Report, July 1, 1975 to September 30, 1976.* Washington, D.C., Government Printing Office, 1977. For an introduction to Sea Grant see: National Advisory Committee on Oceans and Atmosphere. *The National Sea Grant Program: A Review.* Washington, D.C., Government Printing Office, 1976.

[29] U.S. Congress, House, Committee on Appropriations. Departments of State, Commerce, Justice, and the Judiciary, and Related Agencies Appropriations for 1978, Hearings Before a Subcommittee of the Committee on Appropriations. 95th Congress, 1st session, part 4, p. 220.

and Wisconsin: the State University of New York (including Cornell); the State University System of Florida; and the Massachusetts Institute of Technology.

In addition to applied research activities, Sea Grant also provides marine advisory services (discussed later) and educational programs, including two types related to the training of marine professionals: (1) research assistantships and (2) the development of new curricula and course materials for science and engineering students and for marine affairs students. An example of the latter is the marine law program at the University of Washington.[30]

Figure 8-2 shows the numbers of professors, students, and others who have been involved in the Sea Grant program in recent years.

Sea Grant also has programs dealing with precollege marine education and general public education; these are discussed later in this chapter.

In general, the Sea Grant programs are respected and supported by the ocean community. Typical of this viewpoint is the conclusion of the 1976 study by the National Advisory Committee on Oceans and Atmosphere:[31]

> "We find that Sea Grant, as it has developed during its first 10 years, has been responsive to its legislative charter, and has contributed significantly to the Nation's marine effort. We foresee a continuing need for the kind of service it provides. We strongly recommend that the program be continued."

A number of issues dealing with the program's management and direction did arise during the discussions that led to the 1976 amendments to the Sea Grant Act. As a result of those discussions, the 1976 Act specified administrative and managerial provisions in more detail, modified the advisory committee which reviews the program, and made other managerial changes. It also authorized three new programs, one to provide fellowships, a second of nonmatching grants to study specific national policy issues, and a third to improve the marine science and technology capabilities of developing countries and to encourage the international exchange of information. These programs are being funded in fiscal year 1978 for the first time.

Management of the Federal Marine Education Effort

This Nation's basic arrangements for training marine professionals are seldom criticized. In fact, there seems to be general agreement that sufficient numbers of marine scientists, engineers, and others are being trained; that the educational system which trains them is sound; and the basic Federal role in higher education is appropriate.

However, in addition to the concerns mentioned earlier, there is also some discussion about the overall management of the Federal marine education effort. Two specific issues have been raised over the past decade and are still being debated: (1) data collection and (2) interagency coordination.

The Stratton Commission's Panel on Education, Manpower, and Training discussed both issues, and concurred in this finding by its staff:[32]

> "[O]ne of this study's major conclusions is that a stronger mechanism is needed for obtaining and analyzing data on education and training programs and manpower needs and for coordinating federal activities to support the education and training of marine personnel."

Data and Information

The Panel and its staff became aware of the data question when it tried to investigate personnel supply and demand and found "that reliable data were inadequate or non-existent for many aspects of its task."[33] They could not estimate future supply and demand or even find out if there was a marine manpower problem at the time they were preparing their report. In 1969, the Panel recommended the creation of a "Marine Statistics Center." This has not been done.

During the 1960s, there were a number of oceanographic personnel surveys, but by the mid-1970s almost all had been discontinued.[34]

No Federal agency looks at marine employment as a whole. In a sense, then, the Federal Government does not know in detail what the civilian needs are or what impact its policies have. Several new efforts are now underway, however. The Social Science Data Center of the University of Connecticut is now making "The 1977 Survey of Academic Marine Scientists." While it is collecting data on a wide range of subjects, the survey asks the respondents for details about their education and jobs. However, this survey

[30] Sea Grant Annual Report, op. cit. note 28, p. 29.
[31] National Advisory Committee on Oceans and Atmosphere, op. cit. note 28, p. 2.
[32] Panel Reports of the Commission on Marine Science, Engineering, and Resources, op. cit. note 12, p. IV-13.
[33] Panel Reports of the Commission on Marine Science, Engineering, and Resources, op. cit. note 12, p. IV-2.
[34] Robert B. Abel. "The Government's Responsibility in Education," in Marine Technology Society and Institute of Electrical and Electronics Engineers, *Oceans '77 Conference Report* 1: 19A-1 to 19A-4.

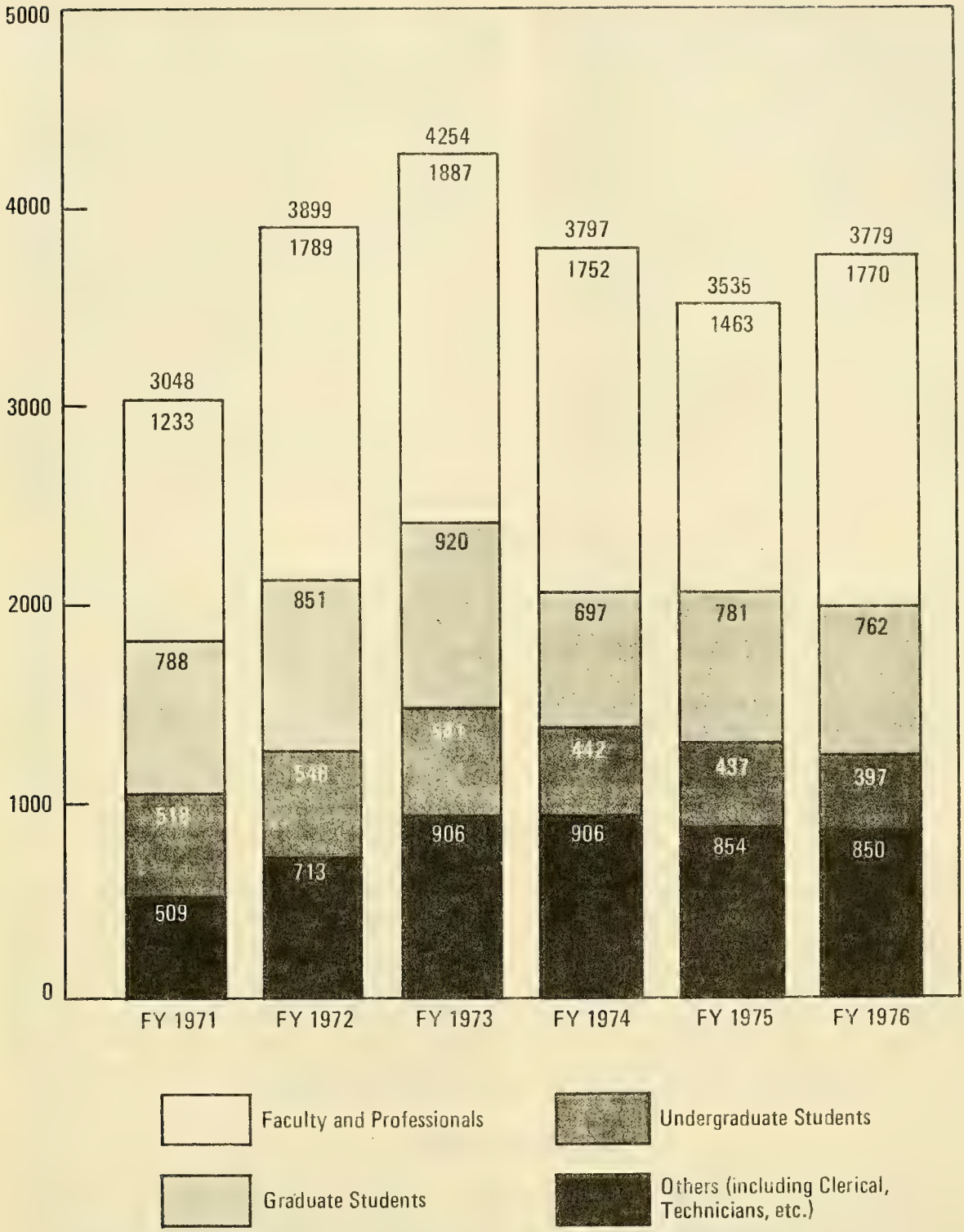


Figure 8-2.—Participants in Sea Grant Program. Source: Sea Grant Annual Report, July 1, 1975, to September 30, 1976. Washington, D.C., Government Printing Office, 1977, p. 62.

focuses on current personnel; it does not attempt to project the future demand and possible supply of academic oceanographers. In addition, education and employment trends in marine sciences are being studied by a new Manpower and Curricula Panel established under the National Research Council's Ocean Sciences Board. It is not yet decided when this panel will report its findings. It has received no specific Government funding to support the activity. The Council's Maritime Transportation Research Board has done considerable work concerning seagoing personnel and recently has begun a new study on "Manpower and Skills for a U.S. Seagoing Workforce."

Also, the National Academy of Engineering's Marine Board is considering undertaking a study of general marine personnel supply and demand, including the need for technicians and skilled craftsmen as well as professionals. No formal study has yet been begun or funded, though.

A number of people are concerned about the lack of good marine personnel data, but the general marine community appears to feel little sense of urgency about this issue. Perhaps a major reason is that some of the same studies that have called for improvements in data collection also have pointed out that there is no major problem in balancing supply and demand. This is partly because of the ease with which professionals can enter or leave the marine field as the employment picture situation changes, and partly because the need for new personnel has not expanded as rapidly as was predicted during the 1960s.[35] There is also the question of how accurate or useful marine personnel projections can be, given both the unpredictability of the field and the fact that informal communication among educators, government officials, and industry may turn out to be more timely and more trusted than statistics gathered by a central office in Washington. More formal studies could help highlight special problems and opportunities warranting the attention of educators, students, government, and others. The policy issue, however, is whether something beyond the existing informal communications network really is needed and, if so, what form it should take to be of most use to the highly decentralized marine education system.

Coordination

Historically, the main interagency coordination mechanism in the marine field was the Interagency Committee on Marine Science and Engineering (ICMSE), now replaced with the Committee on Atmosphere and Oceans (CAO) of the reconstituted Federal Council on Science and Technology. ICMSE had some interest in marine education and published an annual listing of marine programs in colleges and universities around the Nation.[36] CAO, as yet, has not looked at marine employment and education, nor does it appear likely to resurrect any of the now largely defunct data-gathering mechanisms of the 1960s.[37]

Again, the Stratton Commission manpower panel recommended a new organizational mechanism, both to collect marine statistics and to be "a central coordinating body to study total needs, balance Federal agency funding activities, and prepare and administer a national marine education and training program consistent with changing needs in the marine environment." The panel recommended creation of an Office of Marine Education, Training, and Manpower. None has been established.

Today, such ideas still are proposed occasionally, but the issue apparently is not considered urgent by either the Federal agencies or the general marine community. Perhaps this is because there is little opposition to the present system of several different agencies funding marine research and education, perhaps partly because the relevant agencies stay in touch informally and perform the necessary program coordination.

Recently, however, another kind of coordination mechanism—the interagency agreement—has been used in the related area of precollege marine education. During the summer of 1977, Sea Grant and the Office of Education signed an agreement to consult with each other and keep each other informed.[38] Whether such an agreement could improve the coordination of college level marine education programs is an unanswered question.

Major Current Issues

To summarize, while there now appear to be no major policy controversies in this area of training marine professionals, several issues have been raised which are likely to be part of future discussions about marine education. In turn, how these issues are resolved will affect the operation and direction of the Federal Government's marine education effort. These issues, most of which already have been mentioned, are discussed briefly below.

The broadest issue probably will be whether support of university education and research is declining

[35] National Academy of Sciences—National Research Council, op. cit. note 21.

[36] Interagency Committee on Marine Science and Engineering, op. cit. note 19.

[37] Robert B. Abel, op. cit. note 34, p. 19A–2.

[38] "Memorandum of Agreement Between the United States Office of Education and the National Oceanic and Atmospheric Administration," signed August 25, 1977.

seriously, whether this affects marine education, and, if so, what can and should be done. If there indeed is a deterioration in laboratory equipment, an erosion in support for basic research (in inflation-corrected dollars), and other shortcomings, the quality of education as well as research can be expected to decline in the years ahead. Critics of more spending are likely to emphasize the fact that hard evidence of such a decline is lacking, whereas educators are likely to maintain that because research is closely linked to graduate education, a decline in the one will affect the other.

The marine education community will continue to discuss issues related to university teaching: issues such as the balance between teaching and research, how to make today's diverse marine science programs more compatible so that students can move easily from one to another, and how best to teach marine affairs. These are essentially issues of university operation, not Federal policy. However, one can expect proponents of one viewpoint or another occasionally to appeal to Federal agencies for action related to these matters.

The employment data question will continue to be debated. Proponents of more data collection and analysis will argue that better information is vital if the Federal Government is to know where current and future marine personnel needs are. Critics of new efforts may argue that they are unnecessary, given the lack of any major marine employment problems, and unfeasible, largely because no one can reliably predict future needs in this diverse and fast-changing field.

The interagency coordination issue also will continue, though probably at a low level. Critics of more coordination procedures will point to the present informal coordination and to statutes which define each agency's specific role and seem to prevent undesirable overlap and duplication. They also will ask what improvements greater coordination would make.

Maritime Officer Training

For many years the Federal Government has played a significant role in the training of deck and engineering officers for the U.S. merchant marine, though even today Federal and Federally supported schools supply only part of the Nation's maritime officers. The Federal Government also licenses all merchant marine officers.

Providing Federally supported training and licensing personnel are seen as important to the efficiency and safety of the merchant marine during peacetime and to its viability during war or other national emergencies. Maritime education programs are administered by the Department of Commerce's Maritime Administration (MarAd). The licensing functions are carried out by the Coast Guard with the Department of Transportation.

Present Federal Policy

Four main policy objectives guide the Federal Government's maritime officer programs. One is to ensure that the Nation has sufficient numbers of trained officers to meet national defense requirements and to promote commerce. Second, for safety reasons the Government licenses maritime officers and determines the minimum number each ship must have. Third however, Federal programs avoid directing the merchant marine about which particular personnel to hire and under what circumstances. Finally, the Government also has left considerable autonomy to the Federally supported State merchant marine academies, which train many of the Nation's officers. MarAd helps set basic curriculum standards for the schools and influences enrollment levels by setting the number of students who receive Federal subsidies. But the schools receive funding from a number of sources and have great autonomy in deciding how many students to train.

The Federal policy of ensuring sufficient numbers of maritime officers has its origins in the Merchant Marine Act of 1936 (46 U.S.C. 1101 et seq.). Section 101 of the Act is the declaration of policy. In part, it says this:

> "It is necessary for the national defense and development of its foreign and domestic commerce that the United States shall have a merchant marine . . . composed of the best-equipped, safest, and most suitable types of vessels, constructed in the United States and manned with a trained and efficient citizen personnel . . ."

Section 216, which deals with personnel in more detail, was added to the Act in 1938. Subsection (a) authorizes and directs the Secretary of Commerce "to establish and maintain the United States Maritime Service as a voluntary organization for the training of citizens of the United States to serve as licensed and unlicensed personnel on American merchant vessels." Operating as a large training organization during and after World War II, the Maritime Service became inactive during the 1950s, as personnel needs shrank as the size of the U.S.

merchant fleet grew smaller. Subsection 216(b) created the U.S. Merchant Marine Academy at Kings Point, N.Y.

216(c) authorizes the Secretary of Commerce to establish extension and correspondence courses to supplement the training of both maritime officers and seamen. Today, under this authority, the Maritime Administration has established five regional training centers at which short courses are offered on the use of radar, loran, and gyrocompass. These centers are located in New York City, New Orleans, San Francisco, Seattle, and Toledo. A fee is charged for most courses. In addition, firefighting training is offered free of charge on a not-to-interfere basis at the Navy's Military Sealift Command (MSC) firefighting school at Earle, N.J. and at the Navy Training Center, Treasure Island, Calif.[39]

According to MarAd officials, the agency funds such extension courses only where a critical safety need exists and it is impractical or too expensive for the industry to fund them.

In addition to operating Kings Point, MarAd also provides financial assistance to the six State maritime academies in California, Maine, Massachusetts, Michigan, New York, and Texas. The authority for this Federal aid is the Maritime Academy Act of 1958 (46 U.S.C. 1381 et seq.). Under this Act, payments of $1,200 ($600 before FY 1978) per year per student are provided to defray the cost of uniforms, books, and subsistence. Since fiscal year 1974, MarAd has limited the Federal payments to 673 students per entering class, in an effort to keep down the number of students at the State academies. Also, payments of $100,000 per year are authorized for each State academy, though the actual fiscal year 1978 appropriation was $75,000 per school, and federally-owned training vessels are provided to the five "salt-water" schools.[40]

A major concept behind these policies is the connection between transportation and national security —the premise that U.S.-flag vessels are needed in time of emergency—plus the attitude that private sources alone cannot guarantee a sufficient number of maritime officers. There is also the long, traditional view that Government support of commercial maritime operations is warranted. (See chapter V, Marine Transportation.) A related principle is that maritime academy students should be familiar with Navy procedures. It is reflected in the naval science courses taken by subsidized students at Kings Point and all the State academies except Michigan. However, one criticism of the present arrangements is that many maritime officers—particularly the 80 percent who are not academy graduates—have not been given detailed training in such Navy procedures as convoy tactics. [41]

At the same time, Federal policy also is influenced by the idea that while the Government should license officers, the commercial merchant marine operates best with a minimum of Government involvement in day-to-day operations. For instance, there is no legally enforceable requirement that maritime academy graduates serve some minimum amount of time at sea, because the Federal Government cannot require private shipping companies to hire them. However, Kings Point students are required to sign a paper making a "moral commitment" to seek seafaring employment upon graduation.

Sources and Employment of Merchant Marine Officers

There are four major sources of new merchant marine officers: (1) U.S. Merchant Marine Academy, (2) the six State maritime academies, (3) the Calhoon MEBA Engineering School,[42] and (4) the "hawsepipe." [43]

Table 8-4 shows the enrollment and appropriated Federal funds for each of these sources, except for the "hawsepipe."

Tables 8-5 and 8-6 contain MarAd's estimates of present and future demand for deck and engineering officers graduating from the Nation's maritime academies. The main conclusion is that while there is a surplus of new graduates now, there may be shortages of deck and engine graduates in the near future, if the assumptions in MarAd's "best estimate" (most likely) scenario are valid. Another key point reflected here is that academy graduates are hired not only for deep sea shipping but also for work on the Great Lakes, in the Government, in offshore mineral and oil exploration ("M&O"), and for inland ship and barge operations.

One significant feature of the U.S. merchant marine is the strong role of the maritime unions. The principal ones for maritime officers are the Interna-

[39] U.S. Congress, House, Committee on Merchant Marine and Fisheries. Report of the Ad Hoc Select Committee on Maritime Education and Training of the Committee on Merchant Marine and Fisheries on Fiscal Year 1978 Budget Requests for Maritime Education and Training, 95th Congress, 1st session, March 21, 1977, p. 3.

[40] U.S. Congress, House, Committee on Merchant Marine and Fisheries, op. cit. pp. 2–3.

[41] U.S. Congress, General Accounting Office. *The Federal Role in Merchant Marine Officer Training.* Report FPCD–77–44, June 15, 1977, pp. 13–17.

[42] The Calhoon School in Baltimore trains maritime engineering officers. It is operated by the engineers' union, the Marine Engineers Beneficial Association, District 1. The school is named for the union's president, Jesse Calhoon.

[43] Hawsepipe is a nautical term used by the maritime industry to refer to unlicensed seamen who, through self-study and on-the-job training, work their way up through the ranks, meet the Coast Guard's licensing criteria, and receive their initial deck or engineering officer's license.

tional Organization of Masters, Mates, and Pilots (MM&P) and the Marine Engineers Beneficial Association (MEBA). An officer must belong to a union—or be an approved "applicant"—and meet union employment criteria if he or she is to get a job onboard a ship under union contract. These unions control most U.S. maritime officer jobs. In 1975 testimony before the Congress, MarAd estimated that of licensed seagoing jobs on U.S. vessels displacing, 1,000 gross tons and over, MM&P controlled 77 percen of the deck officer jobs and MEBA controlled 79 percent of the engineering officer jobs.[44]

Controversy Over Maritime Manpower

In general, there has been little criticism of the ways officers are trained for work on the Great Lakes and in the offshore and inland operations. And there is little controversy about the number of people being trained for this work, since the supply of officers seems balanced with supply.

This has not bee the case for the deep sea merchant marine, however. Since around 1970 there has been a controversy over who should train officers and in what numbers, and especially whether engine officers should be trained by the academies or by MEBA, the engineers union. The debate has died down somewhat in the last year, but the key issue of who should do the training remains unresolved. An associated issue is what role the Federal Government should play in trying to balance the demand and the supply of maritime personnel.

The controversy occurred because maritime employment dropped sharply around 1970, the result of a general decrease in the number of U.S. ships and jobs and an end of the extra employment associated with the Viet Nam conflict. The two principal officer unions, anxious to ensure that remaining jobs went to their senior members, largely closed their rolls to new academy graduates. Yet the academies—and MEBA's Calhoon School—continued to turn out officers, and a major surplus developed.

MarAd has limited authority to resolve the controversy. Present laws have made it difficult for the Federal Government to ensure that the supply of new officers matches the demand—a demand that fluctuates over time and which was quite low during the early 1970s.

MarAd does prepare plans and can limit the number of students who receive Federal subsidies, which allows some control of enrollments. But at the same time the States rarely have acted to control enrollments, and, moreover, the academies possess considerable autonomy from both the Federal agencies and their State governments. With several sources of funding, plus an American tradition of keeping government influence to a relative minimum, the academies are at liberty to continue training large numbers of graduates if they wish—and some of them have.[45]

Similarly, MarAd cannot exercise control over the union schools, even if it somehow wanted to. The schools are funded by the companies through arrangements specified in union-management contracts.

As a result of all this, MarAd has taken the roles of information-gatherer and forecaster, in order to inform the maritime community of possible future developments and of a mediator who attempts to bring the responsible parties together during times of either manpower shortage or surplus.

Table 8-4.—Enrollment and appropriated Federal funds for the four sources of new merchant marine officers [1]

Source of merchant marine officers	Fiscal year 1976	
	Average enrollment	Federal funds
		million dollars
U.S. Merchant Marine Academy..	1,052	12.7 [a]
State University of New York Maritime Academy	832	1.2
Massachusetts Maritime Academy.	768	1.2
Maine Maritime Academy.....	513	1.1
California Maritime Academy....	331	.7
Texas Maritime Academy.....	93	.4
Great Lakes Maritime Academy..	81	.1
Calhoon MEBA Engineering School	300	.0 [b]
Total:	3,970	17.4

[1] Source: U.S. Congress, General Accounting Office. *The Federal Role in Merchant Marine Officer Education,* Report FPCD–77–44, June 15, 1977, p. 3.

[a] The $12.7 million consists of $8.7 million for normal operating costs and about $4 million for the modernization program.

[b] Federal funds flow directly to the school through contributions made to the MEBA training fund by Federally subsidized shipping companies.

[44] U.S. Congress, House, Committee on Merchant Marine and Fisheries, Maritime Education and Training, Hearings before the Subcommittee on Merchant Marine of the Committee on Merchant Marine and Fisheries on H.R. 1626 and H.R. 9864 [and] H.R. 10413 and H.R. 10500, 94th Congress, 1st session, 1975, p. 14.

[45] For a discussion of the autonomy of the academies, see William R. Rosengren and Michael S. Basis. *The Social Organization of Nautical Education.* Lexington, Mass., Lexiton Books, 1976, pp. 5–7.

Table 8-5.—Maritime Administration's estimate of supply and demand for deck officers graduating from U.S. maritime academies, 1976–85

[Table must be read with accompanying footnotes.]

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Academy graduates [1]	259	238	274	280	282	282	282	282	282	282
Deep-sea demand [2]	65	60	103	226	297	388	484	475	418	418
Net surplus or (deficit) [3]	194	178	171	54	(15)	(106)	(202)	(193)	(136)	(136)
Academy graduates [4]	194	178	171	54	—	—	—	—	—	—
Academy graduates [5]	65	60	69	70	71	71	71	71	71	71
Total academy graduates available [6] for employment in sectors other than deep sea	259	238	240	124	71	71	71	71	71	71
Less Great Lakes demand [7]	0	0	0	0	0	0	0	0	5	18
Net surplus or (deficit) [8]	259	238	240	124	71	71	71	71	66	53
Less Government demand [9]	29	29	29	29	29	29	29	29	29	29
Net surplus or (deficit) [8]	230	209	211	95	42	42	42	42	37	24
Less M&O and towing demand [9]	190	190	190	190	190	190	190	190	190	190
Net surplus or (deficit) [8]	40	19	21	(95)	(148)	(148)	(148)	(148)	(153)	(166)
Less Inland [9]										
Net surplus or (deficit) [8]										
Total academy graduates [10] surplus or (deficit) for maritime sectors	40	19	21	(95)	(163)	(254)	(350)	(341)	(289)	(302)

[1] Represents 80 percent of academy graduates that are assumed to seek jobs in the deep-sea-sector (excluding Great Lakes Maritime Academy). [2] Potential demand for academy graduates after employment of hawsepipe and industry school output. [3] Surplus or (deficit) of academy graduates in the deep-sea sector. [4] Surplus of academy graduates from the deep-sea sector. [5] Represents 20 percent of the academy graduates that are assumed to seek jobs initially in other than the deep-sea sector (excludes Great Lakes Maritime Academy). [6] Represents total of rows 4 and 5. [7] Great Lakes demand for academy graduates in each year after employment of hawsepipe, industry school, and Great Lakes Academy output. [8] Cumulative surplus or (deficit) of academy graduates in each year. [9] Potential demand for academy graduates each year. [10] Total surplus or (deficit) of academy graduates for that given year for both deep-sea and other sectors (excluding Great Lakes Maritime Academy), includes deficit of row 3.

Source: U.S. Department of Commerce, Maritime Administration, Office of Maritime Manpower. *Deck and Engine Officers in the U.S. Merchant Marine: Supply and Demand, 1976–1985*. Washington, D.C., May 1977, pp. 103–104.

Table 8-6.—Maritime Administration's estimate of supply and demand for engine officers graduating from U.S. maritime academies, 1976–85

[Table must be read with accompanying footnotes.]

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Academy graduates [1]	250	241	264	258	262	262	262	262	262	262
Deep-sea demand [2]	63	60	160	191	238	337	414	365	259	230
Net surplus or (deficit) [3]	187	181	104	67	24	(75)	(152)	(103)	3	32
Academy graduates [4]	187	181	104	67	24	—	—	—	3	32
Academy graduates [5]	63	60	66	64	65	65	65	65	65	65
Total academy graduates available [6] for employment in sectors other than deep sea	250	241	170	131	89	65	65	65	68	97
Less Great Lakes demand [7]	0	0	0	0	0	29	35	32	42	44
Net surplus or (deficit) [8]	250	241	170	131	89	36	30	33	26	53
Less Government demand [9]	29	29	29	29	29	29	29	29	29	29
Net surplus or (deficit) [8]	221	212	141	102	60	7	1	4	(3)	24
Less M&O and towing demand [9]	115	115	115	115	115	115	115	115	115	115
Net surplus or (deficit) [8]	106	97	26	(13)	(55)	(108)	(114)	(111)	(118)	(91)
Less Inland [9]	30	30	30	30	30	30	30	30	30	30
Net surplus or (deficit) [8]	76	67	(4)	(43)	(85)	(138)	(144)	(141)	(148)	(121)
Total academy graduates [10] surplus or (deficit) for maritime sectors		67	(4)	(43)	(85)	(213)	(296)	(244)	(148)	

[1] Represents 80 percent of academy graduates that are assumed to seek jobs in the deep-sea-sector (excluding Great Lakes Maritime Academy). [2] Potential demand for academy graduates after employment of hawsepipe and industry school output. [3] Surplus or (deficit) of academy graduates in the deep-sea sector. [4] Surplus of academy graduates from the deep-sea sector. [5] Represents 20 percent of the academy graduates that are assumed to seek jobs initially in other than the deep-sea sector (excludes Great Lakes Maritime Academy). [6] Represents total of rows 4 and 5. [7] Great Lakes demand for academy graduates in each year after employment of hawsepipe, industry school, and Great Lakes Academy output. [8] Cumulative surplus or (deficit) of academy graduates in each year. [9] Potential demand for academy graduates each year. [10] Total surplus or (deficit) of academy graduates for that given year for both deep-sea and other sectors (excluding Great Lakes Maritime Academy), includes deficit of row 3.

Source: U.S. Department of Commerce, Maritime Administration, Office of Maritime Manpower. *Deck and Engine Officers in the U.S. Merchant Marine: Supply and Demand, 1976–1985*. Washington, D.C., May 1977, pp. 103–104.

To examine this controversy and MarAd's situation, the House Merchant Marine and Fisheries Committee established a special Ad Hoc Committee on Maritime Education and Training. It and the Committee's Merchant Marine Subcommittee held a series of hearings on the subject during 1974 and 1975.[46]

During these hearings MEBA argued that it should play a major role in training new engine officers, and the academies argued that they should play the major role. Each group blamed the surplus of officers on the other. There were also other criticisms. The academies accused MEBA of hiring discrimination, saying not only that the union was taking few new members, but also that its rules enabled Calhoon School graduates to get the few new jobs that existed. MEBA in turn argued that the academies had no business turning out large numbers of new officers when there were no seagoing jobs for them.

It appears that the academies and MEBA each had a point. The Calhoon School was intended to meet the perceived Viet Nam era shortage of engine officers, but was continued after the war and now supplies about one hundred new officers each year. The school receives Federal money, albeit indirectly. Its funds come from the shipping companies, as determined by labor contracts. Many of these companies receive MarAd operating differential subsidies and since 1974 have been able to receive subsidies to cover much of these training expenses.[47]

Most importantly, MEBA gave employment preference to Calhoon School graduates over academy graduates. The General Accounting Office has described how this worked.[48] Essentially, MEBA created a category for new engineers with a certain amount of training at sea on MEBA-controlled ships; those in this category got jobs, whereas those not in it rarely did. Calhoon School graduates met this requirement, academy students trained on academy ships did not.

At the same time, however, it is also true that generally the academies did not cut back their enrollments and continued to graduate large numbers of officers, even though the deep-sea employment situation was bleak and MarAd had imposed a ceiling on the number of Federally subsidized students. Being semiautonomous, they continued to operate largely as before. In fact, in the late 1960s there was some expansion of the student bodies, particularly at the Massachusetts school.

In the debate over who should train officers and in what numbers, academy proponents made several arguments. One—made now as well as then—is that the schools and their enrollment levels should be judged not only because they contribute to the deep-sea fleet, but also because their graduates do valuable work in shore-based maritime jobs, in inland and offshore operations, and in the Navy. Others argue that a college education is good preparation for an officer and, moreover, is beneficial because it gives a young graduate a wide range of future job options.

Recently, some also have argued that academy enrollments should be maintained because of the possible future shortages of young officers. If it is true that the era of surpluses is ending, they say, then this is not the time to reduce the academies' role in supplying both deck and engine officers.

Others disagree with these points. Critics point out that these colleges are the only instances of the Federal Government providing education in support of a private civilian industry, and argue that Federal support is justified only to the extent that they train people who will be available in case of national emergency. Some proponents respond that in an era when Federal and State governments spend large amounts of money on higher education, some $17 million a year is not an excessive amount to spend in support of valuable schools with a long tradition of Government involvement.

In 1975, the House Ad Hoc Committee issued a set of conclusions and recommendations based on its investigations. The main finding was:[49]

> "[T]he cyclical nature of the maritime industry requires the imposition of quantitative controls on the flow of licensed officers into the maritime labor market. Basic principles of fairness demand that such quantitative controls be developed through a sound system of prospective planning. This type of planning has been seriously lacking in the past. It is therefore recommended that the Maritime Administration be directed to hold a meeting each year of representatives of all maritime schools which train individuals for initial licensing as officers for the purpose of establishing Federal support levels by discussing and relating incoming enrollment levels of these institutions to the future numerical requirements of the U.S.-flag merchant fleet for licensed officers."

Beyond acknowledging the problem, this statement by the Committee also recognizes two other factors. One is that the main leverage that MarAd has is setting "support levels," mainly the number

[46] Ibid., which covers most of the basic issues and arguments involved in the controversy.

[47] Ibid., pp. 12–13.

[48] U.S. Congress, General Accounting Office, op. cit. note 41, pp. 18–19.

[49] U.S. Congress, House, Ad Hoc Committee on Maritime Education and Training. Report of the Ad Hoc Committee on Maritime Education and Training on Principal Institutions in the United States Which Train Individuals for Initial Licensing as Merchant Marine Officers. 94th Congress, 1st session, Serial No. 94-D, 1975, p. 21.

of students who will be subsidized each year. At the same time, the report seems to note implicitly that this is an imperfect lever of control at best, and that mediation and discussions among the involved parties are equally important. Legislative proposals based on this and other recommendations were introduced, but were not acted upon by the 94th Congress. These issues now are being examined by a new House Ad Hoc Select Subcommittee created in the 95th Congress.

Today the underlying issues remain unresolved: the question of who should train maritime officers, and the associated question of whether MarAd or perhaps others should be given a larger role in ensuring that the supply of officers trained by the academies and the unions is balanced with demand.

But for the moment, the debate had died down. Today there appears to be enough sea-going employment for all who want it, largely because of increasing retirements among merchant marine officers. One result of this improved job situation is that MEBA now has rewritten its shipping rules to allow new academy graduates into the union on a more equal footing with graduates of the union's school. Whether this present demand for officers continues depends on many things, including future Federal policies regarding cargo preference, shipping subsidies, and manning and safety requirements. Yet in any case, the issues of how to train officers and in what numbers are likely to remain.

Licensing and Retraining

In recent years ships around the world have been sinking at an alarming rate, an average of about one a day. In the judgment of a National Research Council (NRC) study of the problem, human error is often a contributing if not fundamental factor in these sinkings and other maritime accidents. The NRC study concluded:[50]

> "Marine casualties and their effects, including loss of life as well as ecological and cost considerations, are far more serious than is realized; this is especially disturbing since at least 80 percent of casualties are related to human error."

The NRC work on this question of human error has helped to make it a significant maritime personnel policy issue. It is also a controversial one. In 1975 hearings before the House, the maritime unions disagreed among themselves about this subject, especially the idea of requiring periodic physical examinations for U.S. maritime officers. The representative of the International Organization of Masters, Mates, and Pilots (MM&P) had no objection to a requirement for physical examinations, but two other unions felt otherwise. Jesse Calhoon of the Marine Engineers stated that MEBA members already undergo a biennial physical examination and was against Government examinations. He also opposed another idea, that of reexamination to ensure that basic skills have been maintained. The radiomen and radio officers' unions, which also opposed requirements for physical examinations and reexamination of skills, were clearly worried about the impact these might have on jobs.[51] Others question whether the available data fully support the panel's contention that certain steps, such as additional physicals, actually will improve ship safety.

While the education, licensing, and qualification of merchant mariners are an international problem, any discussion of U.S. Merchant Mariner qualifications and documents usually starts with the requirements of the U.S. Coast Guard. To qualify for an original license as a Merchant Marine officer for service on U.S. flag merchant vessels, an applicant must present qualifying sea service or be a graduate of a Coast Guard-approved licensing program, and must pass a physical and professional examination. In addition, these licenses must be renewed every 5 years. Upon renewal a deck officer must show recency of service under the authority of his license within the preceding 3 years, complete an open book exercise on rules of the road and pollution abatement, pass a color sense test, and take a written examination for "radar observer." To renew his license, an engineering officer must complete an open book exercise on pollution abatement.

To sail in an unlicensed capacity aboard a U.S. flag merchant vessel of over 100 gross tons, all seamen must obtain a U.S. merchant mariner's document issued by the Coast Guard. Applicants for the "entry ratings" or ordinary seaman, wiper, and member of the steward's department must present a letter of commitment of employment for service on U.S. flag merchant vessels to be eligible for a merchant mariner's document. Applicants for "qualified ratings" such as able seaman and qualified member of the engine department must present qualifying sea service or complete a Coast Guard approved course of instruction, and pass a physical and professional examination.

Retraining for officers and seamen is available now through MarAd's training centers and a series of union schools. For instance, MM&P operates a highly regarded Maritime Institute of Technology and Graduate Study near Baltimore, Md

[50] Panel on Human Error in Merchant Marine Safety, Maritime Transportation Research Board. *Human Error in Merchant Marine Safety*. Washington, D.C., National Research Council, June 1976, p. v.

[51] U.S. Congress. House, Committee on Merchant Marine and Fisheries, op. cit. note 44, pp. 125, 160–161, and 176.

The NRC panel's overall conclusion is that this system of licensing and retraining can and should be improved. The panel found 15 factors that are either actual or potential causes of casualties or near-casualties.[52] They are:

(1) inattention,
(2) ambiguous pilot-master relationship,
(3) inefficient design of ships' bridges,
(4) poor operational procedures,
(5) poor physical fitness,
(6) poor eyesight,
(7) excessive fatigue,
(8) excessive alcohol use,
(9) excessive personnel turnover,
(10) high level of calculated risk,
(11) inadequate lights and markers,
(12) misuse of radar,
(13) uncertain use of sound signals,
(14) inadequacies of the rules of the road, and
(15) an inadequate data base regarding marine casualties.

The report also makes recommendations on each factor. These include suggestions that the Coast Guard require periodic physical examinations, mandate new equipment to prevent collisions and accidents, and improve rules of the road. They also suggest that MarAd improve education, training, and retraining programs; develop a system for qualifying crew members by vessel type; study of job satisfaction, fatigue, and abuse of alcohol and drugs; establish new standards regarding radar; and work with the Coast Guard to improve navigation aids and markers.[53]

The maritime safety issue took on a new urgency during the winter of 1976–77, when the *Argo Merchant* and a number of other tankers were involved in major accidents off the U.S. coast. President Carter discussed these accidents in a March 18, 1977, statement announcing actions to reduce maritime oil pollution. This statement called for new crew standards and training, as well as stricter construction and operating standards for tankers and stricter Coast Guard enforcement of such standards. Specifically, the President directed the Departments of Transportation and Commerce to review the draft agenda for Inter-Governmental Maritime Consultative Organization's 1978 Conference on Standards of Watchkeeping and Training and consider possible additional requirements. Furthermore, the President directed Transportation to take immediate regulatory action to improve standards for U.S. crews, including requirements based on class and size of vessel and more emphasis in licensing examinations on demonstrating important skills, such as radar operation and interpretation. These requirements will apply to both issuance and renewal of licenses for shipmasters, mates, and federally-licensed pilots.[54]

Both the Coast Guard and MarAd now are taking steps based on these orders. At the same time, the controversy over present Federal policy continues.

Major Current Issues

It is likely that some debate regarding both maritime safety and the supply of maritime officers will continue. For despite recent actions dealing with these issues, some observers believe that the underlying problems have yet to be addressed fully.

For the moment, the maritime academies and the maritime unions appear to be at peace on the question of who should supply merchant marine officers and how they should be admitted to the unions. The reason, however, is that there appear to be enough jobs for everyone now, not that underlying questions about the roles of the academies and the unions have been resolved. If present officers continue to retire in large numbers and employment opportunities for new officers continue, as MarAd predicts, then the debate probably will simmer at a low level. However, if the job market becomes depressed, it is likely that the old debates that plagued the maritime manpower community during the first part of the 1970s will reappear. It is also likely that both MarAd and others will continue to find it difficult to resolve the problem, given the fragmented nature of the system that both trains and hires maritime officers.

Maritime safety will continue to be an issue. Of course, it involves questions of ship construction and maintenance as well as personnel, but these personnel questions will be debated further because human error continues to be a major cause of marine accidents. In 1978 it is likely that the focus will shift from national policy to the international discussions at the meetings of the Inter-Governmental Maritime Consultative Organization (IMCO).

[52] Panel on Human Error in Merchant Marine Safety, op cit. note 50, pp. 7–11.

[53] Ibid., pp. 15–18.

[54] See the President's March 18, 1977, message to the Congress regarding actions to reduce maritime oil pollution, as well as the accompanying "fact sheet."

Vocational and Technical Training

Traditionally, the vocational training system in this country has been decentralized and the Federal role limited. Some vocational training is done through high schools, private vocational schools, community colleges, and a few programs run by colleges and universities. Much is done outside the regular public and private schools, through on-the-job training, apprenticeship programs, and industry and labor schools. The armed services also have large training programs; many skilled laborers now in the civilian workforce were trained in the military. Altogether, the programs available both in and out of the military are incredibly diverse, ranging from informal advice from extension agencies and special training and retraining courses lasting a few days to 2-year college certificate programs for certain highly trained technicians. These points apply to marine and maritime as well as land-oriented occupations.

The Federal role in vocational education goes back to the early part of this century, but generally has been limited to providing financial and other assistance to the States and industry, rather than operating Federal schools. Exceptions have been the military training programs and some programs in the civilian agencies. Along with this financial assistance, the Federal agencies also encourage planning. Both the money and the planning are seen as necessary to ensure the Nation has the proper balance between employment supply and demand.

Present Federal Policy

Two levels of Federal policy affect marine and maritime vocational education. And the Federal role in both has been shaped by the twin objectives of helping to assure sufficient supplies of manpower while also limiting the Federal role in the operation or administration of schools.

On one level, some programs deal specifically with marine and maritime training. The Sea Grant program is one; among other functions, it trains technicians and provides advice to people in marine businesses. The previously mentioned MarAd training schools are another example. These federal programs help support and supplement the Nation's large State and private training efforts, such as the network of union schools which train merchant seamen and various other schools specializing in divers, technicians, and other marine workers.

Second, there are Federal programs which deal with vocational education in general. While only a small number of the people they train ever work in the marine or maritime fields, they nonetheless must be considered because the vocational schools they support supply many of the skilled workers of the ocean industries. In addition to the two general objectives of assuring manpower but limiting the Federal role, some of these programs also have a third objective: reducing unemployment and underemployment.

Basic Federal vocational policy has resulted from a long line of vocational education acts passed by Congress, starting with the Smith-Lever Act of 1914. The main law today is the Vocational Education Act of 1963, recently revised by the Education Amendments of 1976. The Act is administered by the Office of Education in the Department of Health, Education, and Welfare. Its goal is to help provide "ready access to vocational training and retraining which is of high quality." It provides Federal grants to the States to help them develop new programs and maintain existing ones.

The third objective—reducing unemployment and underemployment—is reflected primarily in two acts. One is the Comprehensive Employment and Training Act of 1973 (CETA), as amended. Its purpose is to create jobs through both public employment jobs and training programs. As elsewhere, the Federal program is intended to assist State and local efforts. In this case, CETA provides job and training money to over 400 "prime sponsors"—state and local agencies—to design and manage operations. Several other activities under CETA are run directly by the Labor Department, which administers the Act. The Job Corps is one of them.

While CETA programs are premised on the notion that the Federal Government should be the employer and trainer of last resort, the programs of the Department of Commerce's Economic Development Administration (EDA) award funds to private companies, often construction companies, in order to increase employment in high unemployment areas. In the process, EDA stimulates some on-the-job training and also creates additional demand for people with formal vocational training.

The general result of this increasing number of Federal programs is two-fold: to fragment Federal manpower efforts further and to reinforce the Nation's present decentralized system of vocational education.

Neither CETA nor EDA plans its programs in terms of providing a given amount of manpower for a given field, such as marine and maritime. Instead, it is left to the individual CETA "sponsors" or applicants to EDA to decide which types of persons are employed or trained. As a result ,it is difficult to obtain statistics on the number of marine-related people and projects supported by the programs. For instance, EDA is funding a number of aquaculture projects, but details are not readily available. However, presumably these programs could be directed to focus more on the marine field, if this were to be a principle of national policy.

The Office of Education does look at the personnel needs for specific sectors of the economy, but usually only on a selective basis, examining special problem areas. This appears to reflect a general feeling in the vocational field that most manpower needs can be met through a combination of private efforts, State programs, and some general financial assistance from the Federal Government.

Certainly, this is true in the marine area. For instance, while there are special Federal programs for training merchant marine sailors, training in other fields, such as the offshore oil-drilling industry, operates without direct Federal involvement. In the offshore drilling area, training is provided through private schools and through a network of special programs sponsored by the industry trade association and operated by college extension programs. Furthermore, the industry considers these training courses—usually 2 days to 4 weeks—to be supplements, not replacements, for the more important on-the-job training. However, it is also true that a recent survey of the industry indicated that most would cooperate and participate in a joint Government-industry program to help deal with the shortage of well-trained drilling hands.[55]

The drilling company executives, who traditionally have been content to run their own programs, but now may ask for Federal help, reflect a general attitude in the vocational field: That special Federal programs to meet the training needs of a particular industry usually are requested only when the industry feels it cannot perform the training on its own. It is in such circumstances that the Office of Education pays special attention to the manpower needs of a particular sector of the economy. A marine example comes from the shipbuilding industry, which was hit by a major labor shortage in the early 1970s, largely due to simultaneous expansion of both commercial and Navy shipbuilding. The increase was complicated by unusually high employee turnover.[56]

The vocational bureau of the Office of Education began to work on the problem, as did MarAd and the Department of Labor. Even here, though, the Federal agencies did not begin any new special training programs; instead, they gathered detailed information and distributed it to State directors of vocational education in order to notify them about the job opportunities and personnel needs in this field.[57] Apparently this position reflected the attitude that actual training is best left to the States and industry and that the appropriate Federal role in ship construction personnel is to assist these efforts.[58] And, indeed, the ship construction industry has expanded its own network of training schools.

This pattern of industry meeting its own manpower needs—often with help from the States, sometimes with special help from Federal agencies—is repeated throughout marine industries. One other example is the commercial diving industry. Some years ago the need for trained divers became acute, largely because of expanded offshore oil operations. In response, existing schools expanded and new programs were started, and the industry's manpower situation is better today.[59]

All of this notwithstanding, there have been cases where Congress has established special Federal programs to meet the perceived special training needs of particular fields. In the marine area, the largest are those of the Navy and Coast Guard where special training commands were established to meet the service's manpower needs. The main civilian Federal program training vocational personnel is Sea Grant.

Sea Grant has two vocational training efforts, in the broad sense of that term. One helps support the training of technicians, most of whom receive 2 years of training in community colleges. During fiscal year 1976 and the transition quarter, Sea Grant supported 23 projects in technician training with about $400,000 in Federal funds; matching funds from States and private sources totaled more than $1 million. Two projects produced oceanographic technicians for research vessels, two trained commercial divers, and others emphasized commercial fishing, marine applications, welding, marine electricity and electronics, and repair and maintenance of diesel and gasoline engines. The National Sea Grant Office encourages the schools involved to maintain close

[55] *The Oil and Gas Journal*, September 19, 1977, pp. 149 ff.

[56] Edward F. Mackin and Roger D. Anderson. op. cit. note 1, p. 34.

[57] Wm. Paul Gray, Memorandum to Regional Office Personnel on "Needed Information on Manpower for the Shipbuilding Industry," Office of Education, March 31, 1976.

[58] However, for many years the Federal Government has supported apprenticeship programs which train workers at the public shipyards.

[59] Glen H. Egstrom. "Industry Programs for Marine Education and Manpower," in Marine Technology Society and Institute of Electrical and Electronics Engineers, *Oceans '77 Conference Report* 1: p. 37A-1.

contact with marine industries and other potential employers of the graduates.[60]

The other Sea Grant program is the Marine Advisory Service. When the original Sea Grant legislation was being drafted, there was concern about how to transfer research results into the hands of people who could use it, such as fishermen and ocean engineering firms. The model turned to was the county agricultural extension agent, and as a result the legislation called for Sea Grant versions of these agents. In 1976 there were more than 225 such agents around the country, most of them attached to Sea Grant Colleges, and some attached to State agencies. During fiscal year 1976 and the transition quarter, $8,627,000 in Federal funds and $4,755,000 in matching funds were spent on Marine Advisory Service activities.[61]

Major Current Issues

There appears to be little controversy about the basic organization of marine vocational training systems or about the Federal role. Nor is there much controversy concerning the Federal policy on vocational education in general. Perhaps this is because the present marine education system generally provides the personnel that the country needs. One reason may be that most areas of marine employment are growing only slowly, though steadily. Another may be that many marine jobs require little specialized training, such as sales personnel; or skills readily available from the land-oriented workforce, such as those of secretaries and other support personnel; or the kinds of skills learned primarily on the job, such as in the case of fishermen and longshoremen.

However, there are several issues that have been discussed. One, previously mentioned, is whether the Federal Government should become more involved in the training of workers in such fields as offshore oil-drilling and ship construction—industries where there are not only personnel shortages, but also strict Government regulation and increasingly sophisticated technology which require workers to be more skilled than ever. Proponents of a larger Federal role argue that increased involvement is necessary to ensure that the country has the skilled workers it needs in these fields. Critics argue not only that the traditional Federal role in this area has not been large, but also that the present decentralized system appears to be functioning reasonably well. They may ask for evidence of any case—even in the shipbuilding industry—where personnel shortages have been so bad that major projects were seriously delayed. It is likely that any new Federal initiatives in this area will be joint Government-industry efforts, with industry and local public and private schools administering the programs and the Federal Government providing special financial assistance and support services.

There has been some recent controversy about new Federal efforts to regulate marine personnel. To date, these debates have focused on Government efforts to regulate operations, not training. The controversy over proposed Coast Guard and Occupational Health and Safety Administration (OSHA) regulation of the commercial diving industry is an example. It is possible, however, that the debate may expand into discussions over whether to set minimum standards for such personnel as divers.

There is some concern about the lack of detailed data on marine manpower supply and demand, an issue discussed earlier in the section on marine professional manpower. Some pilot studies of the marine manpower situation for given regions have been completed recently.[62] Proponents of these studies consider the reports to be necessary if educators and students are to have a full understanding of current and projected manpower needs. They would like to see more studies performed, perhaps with Federal financial support. Critics of the reports are likely to question the reliability of the methodology and projections. They also will ask whether existing informal communication among educators, industry officials, and policy makers is not sufficient to meet the needs of the relatively small, close-knit oceans field.

There appears to be little Federal interest at the moment in gathering detailed marine personnel statistics. The Bureau of Labor Statistics, the main agency involved in collecting employment data, does not generally make a distinction between marine and land-oriented employment. However, there is some new interest in vocational personnel statistics in general: the Education Amendments of 1976 directed the Office of Education to establish a new National Occupational Information Coordinating Committee to help vocational educators and others seeking information.

[60] Sea Grant Annual Report op. cit. note 28, pp. 30–32.

[61] Sea Grant Annual Report, op. cit. note 28, pp. 35–41

[62] Olympus Research Corporation. *The New England Region Marine Manpower Situation, 1974–1985*. Boston, Olympus Research Corporation, February 28, 1977. This report is part of the Marine Industry Education Project supported by the New England Regional Commission. See also: South Atlantic and Gulf Marine Manpower Project. *Survey of Current and Future Manpower Requirements, 1977–1980*. Jacksonville, Florida Junior College, July 1977. This is a report to the Coastal Plains Commission.

Public Education

Public education includes three activities: (1) precollege education for students who may become specialists in marine science, marine affairs, or related fields; (2) general precollege, college, and adult education for people interested in studying marine topics, but not in becoming marine specialists; and (3) public information programs intended to foster citizen awareness and aid public participation in Government decision-making. Small, but significant efforts now exist in all three areas, although they are recent developments.

Two general objectives appear to guide Federal marine public education programs and similar programs in nonmarine areas. One of course is to help both educate students and inform citizens. Second, like other Federal education efforts, these programs are designed to minimize Federal involvement in the actual management of schools and other institutions that inform citizens, such as the press and political organizations. The aim is to reduce the risk of a Federally dominated "monopoly" of information or ideas. The tension between these two objectives has led to the creation of Federal public education programs, but with strong public and Congressional wariness about them.

College Preparatory Programs

The goal of Federal assistance in college preparation—marine and otherwise—is reflected in the philosophy and operation of the National Science Foundation (NSF). Along with summer institutes for college teachers and the development of new college curricula, NSF has long been involved in parallel efforts at the precollege level. However, none of the major precollege curriculum development projects has dealt with marine science. Instead, NSF has adhered to a policy of developing new materials for the traditional science and social science disciplines, such as physics, biology, and economics. NSF seems to feel that high school training in the basic disciplines is the proper background for students, whether they are going into a traditional field or an interdisciplinary one such as marine science. Whereas the Office of Sea Grant funds the development of general precollege marine curricula, it is NSF that continues to be the major Federal agency supporting the development of precollege science education.

Today, three NSF programs have the major responsibility for precollege science education. One is the Pre-College Materials Development, Testing, and Evaluation Office, part of the Division of Science Education Development and Research in NSF's Directorate for Science Education. The fiscal year 1977 budget for this program was $1,540,000. Another is the Information Dissemination Program of the Directorate's Division of Science Education Resources Improvement. Budgeted at $400,000 during fiscal year 1976, this program uses workshops and conferences for secondary school officials and teachers to inform them about new classroom materials, practices, and technologies. This Division also has a number of programs to assist undergraduate science education. Finally, there is a Secondary School Student Science Training program, funded at $2 million in fiscal year 1977, which operates summer programs for high school students. Of the approximately 150 courses held during the summer of 1977, six focused on marine-related topics.[63]

One other marine-related precollege effort is the Navy's "junior ROTC" program for high schools.

General Marine Education

Present Federal Policy

The objective of assisting education—in this case, general marine education for precollege students, college students, and adults—is reflected primarily in the Sea Grant program, which has long had a mission much broader than science and science education per se. Several ideas underlie the notion that the Federal Government should help promote general education for nonspecialists in such fields as the marine area. One is the older notion that people should have a broad education, and not simply be specialists in their field of employment; this is partly for reasons of personal enrichment, and partly because of a belief that the citizens of a democracy should be informed about a range of matters. Also involved is the newer idea that marine subjects should be taught in the schools, partly because marine resources are becoming more important to the country's prosperity and well-being, and partly because the associated Government programs and policy issues are becoming more complex.

The notion of limiting Government involvement in education applies here as elsewhere. As a result, the NSF-type concept of a Federal program to develop new curricula, sponsor special teacher training, or provide general lecture activities often is used as a model for the general marine education efforts of Sea Grant and others.

[63] Budget information from U.S. Congress, House, Committee on Appropriations, op. cit. note 29, pp. 846–847, 835–836, 816.

Federal Programs

While NSF has not developed precollege curricula that deal with marine topics per se, the new marine science college courses that it has helped to develop have benefited nonspecialists as well as students who plan to go into marine science or engineering, or related fields. In addition, the Foundation's Public Understanding of Science Program is involved; recently it funded a traveling lecture series entitled "Voyages Into Ocean Space."

The Office of Education administers the Environmental Education Act (Public Law 91-516). Some of the activities of the Office under this Act deal with the marine environment. The fiscal year 1978 budget for the entire program is $3.5 million. Of this, about half goes to the support of elementary and secondary education, mostly for the development of new curricula. About 30 percent of it goes for adult community education, and the remaining portion supports research and development contracts.[64]

The Coast Guard coordinates a national boating safety education program in cooperation with all the States and various safety organizations. Financial as well as technical and administrative assistance is provided. The 46,000-member volunteer Coast Guard Auxiliary also is active in boating safety education. One ongoing program is to introduce boating education into the public school systems and to certify instructors. The Coast Guard also distributes boating safety information to the media to build public awareness about safety.

However, the Office of Sea Grant is the main agency in the field of general marine education. These activities are conducted through both the regular Sea Grant college programs and workshops and other programs of the Marine Advisory Service. During fiscal year 1976 and the transition quarter, the "Other Education" category included 55 projects supported by more than $2 million in Federal funds and $1.3 million in matching funds. Most of this money goes for traineeships and the development of new marine courses and curricula on both college and precollege levels. One major program is at the University of Delaware, where curricular materials in marine subjects for kindergarten through high school have been developed and evaluated. Its set of 75 learning units relating to the marine and coastal environment have been distributed nationwide.[65]

Recent Developments

In the past 2 years, both the Sea Grant Office and the Office of Education have been developing new policies for general marine education. They have also been in contact with each other, a step which recently led to an agreement between the two agencies to share information and coordinate programs.

Both agencies seem to be influenced by growing public interest in marine education. One indication of the interest is an increasing number of marine courses around the country. Another is the recent creation of a *Journal of Marine Education*. This trend appears to be influenced by the general national interest in the environment, and in fact "the new approach" in marine education is concerned with more than just marine science.

The Office of Education's interest in the marine environment is reflected in its support of the previously mentioned University of Delaware project on curriculum development. However, the Office also is interested in developing new materials to inform students about marine careers; this is part of its overall "career education" program. A 1975 study funded by the Office examined general marine education, particularly the career-oriented part, and appears to have stimulated much of the current Federal interest in the subject.[66]

At about the same time, people from the various Sea Grant colleges began discussing what Sea Grant's role should be in precollege marine education. An April 1976 workshop at the Virginia Institute of Marine Science (VIMS) at Williamsburg, Va., examined the possible need for a redefinition of the Sea Grant role in this field. The result was an agreement that the oceans are increasingly important; that there is need for a "marine-literate" society as well as for programs which train marine professionals, technicians, and public managers; and that Sea Grant should be a catalyst in developing a new approach to marine education.

A quasi-official rationale for this new approach was developed after the conference by Harold Goodwin, formerly associated with the Office of Sea Grant.[67]

In a related document, Goodwin mentions that NSF, the Office of Education, and State and local agencies are involved in marine education. Then he adds, "But to other Federal agencies, marine education activities of any kind are peripheral to their main concerns, and Sea Grant remains the home and focus for marine education."[68] Goodwin and others are

---

[64] U.S. Congress, House, Committee on Appropriations. Departments of Labor and Health, Education, and Welfare Appropriations for 1978, Hearings before subcommittee of Committee on Appropriations, 95th Congress, 1st session, part 5, p. 45.

[65] Sea Grant Annual Report, op. cit. note 28, pp. 32, 39–40. The University of Delaware program also has been supported by the Office of Coastal Zone Management, the Office of Environmental Education, and others.

[66] U.S. Department of Health, Education, and Welfare, Office of Education. *Marine Education: Guidelines for Curriculum Development*. Boston, Olympus Research Corporation, June 1975.

[67] Harold L. Goodwin. "An Introduction to Marine Education." Newark, Del., University of Delaware Sea Grant College Program, April 1977 draft for comment.

[68] Harold L. Goodwin. "Perspective on Sea Grant Marine Education." Waimanalo, Hawaii, The Oceanic Institute, August 1975.

still formulating ideas about the exact role Sea Grant should play in this field; early recommendations focus on a liaison and coordination role for the national Sea Grant office and curriculum development and liaison roles for the Sea Grant colleges.

In stating the position of the Office of Sea Grant on precollege education, Director Ned A. Ostenso wrote to directors of Sea Grant Colleges, Institutions, and Programs in March 1977:

> "The Office of Sea Grant strongly endorses the position that marine topics are an important element of a balanced pre-college educational program and recognizes that no single curriculum or program is adequate to the needs of the Nation.
>
> "The expertise and infrastructure of the Sea Grant system can and should contribute to improving the marine content of pre-college education through cooperation with and support of local, regional, State, and national organizations and agencies that foster and are responsible for pre-college education.
>
> "These Sea Grant-sponsored activities supporting pre-college marine education will be conducted through existing administrative procedures. No special guidelines will be promulgated."

Precollege education now is considered an integral part of the Sea Grant Program, and in fiscal year 1977 Sea Grant increased its spending in this area by 300 percent. On August 25, 1977, the U.S. Commissioner of Education and the Administrator of NOAA signed a "memorandum of agreement." In the words of an accompanying press release, its purpose is "to help develop a coordinated marine environmental education program at Federal, State, regional, and local levels." Under the agreement, the agencies will share information and the Office of Education will encourage State departments of education, educational organizations, and colleges to work closely with existing marine-oriented institutions and programs such as the Sea Grant colleges. Special emphasis will be placed on Sea Grant projects dealing with the marine education of inner-city and minority children.[69]

Sea Grant officials emphasize that this will not result in a new spending program, but rather is aimed at redirecting existing programs and improving coordination between the two agencies.

At this point, it is unclear what specific direction these efforts will take or what will result. To date, the proponents of the new approach in general marine education have focused on developing a rationale and a basic strategy; we will have to wait for the details. In addition, if proponents want increased Federal funds for this effort, they will have to convince the Government that there is a pressing need for a larger Federal effort and that it deserves higher priority than other educational programs.

Public Information

Federal Policy

Two basic concepts underlie the public information programs of the ocean agencies. One is the traditional concept that the Government should make information on its programs available to help inform the citizenry. However, there are certain difficulties here, reflecting tension between the overall objectives of providing Federal assistance while at the same time assuring that the Federal role remain limited and controlled. There is the question of who should present this information to the public; by-and-large, the traditional American approach has been to let intermediate institutions such as the press filter the Government-supplied information. There is also tension over the related question of when the legitimate efforts of an agency to publicize its actions become an effort to propagandize. In general, the present American answer to this dilemma again is to let the press and others select what they will and will not be passed on to the public.

Results of the first concept are the traditional public information programs of the agencies, which focus on issuing press releases, facilitating interviews and giving other assistance to the press, answering requests from the public, and issuing some general brochures or providing speakers that describe the agency and the importance of its mission. One variation on this theme is the Sea Grant Communications program which uses radio and other media to distribute educational materials.

However, in recent years another, often controversial, concept has influenced the agencies. This is the notion that Government offices should help, or at least not hinder, efforts by the public to participate in Government decision making. This concept itself is a reflection of citizen awareness of the size and impact of new Government programs, such as those in the marine field, coupled with what one author calls "the primary purpose of citizen participation—increasing the responsiveness and accountability of Government to the citizens affected by public decisions." [70]

The concept of Government aid to public participation appears to have two parts: increasing ac-

[69] U.S. Department of Commerce. "NOAA, Office of Education Sign Marine Education Pact," News Release NOAA 77-281, November 15, 1977

[70] Nelson M. Rosenbaum. *Citizen Involvement in Land Use Governance*. Washington, D.C., The Urban Institute, 1976, p. 1.

cess to information and structuring decision-making processes so that citizens actually can affect decisions. The latter is a matter of organization. But the emphasis on more information has led to major changes in the way agency public information programs operate. The Freedom of Information Act has required agencies, including ocean agencies, to be more open. The environmental impact statements required under the National Environmental Policy Act of 1969 in effect require agencies to inform, before decisions are made, what the proposed action is, what impacts it is likely to have, and what the alternatives are. More recently, some agencies, such as the Nuclear Regulatory Commission, have provided technical assistance to citizens "intervening" in adjudicatory hearings. There is now a debate over whether agencies such as NOAA also should provide financial assistance to such "interveners" in order to enable them not only to participate in proceedings, but also afford access to researchers and experts who can provide them with information.

Programs and Recent Developments

Nearly all Federal agencies operate information offices. The public information role is recognized as a legitimate function of the agencies. There is a risk, however, that well-intentioned agency information programs can be used as promotional tools to advance the parochial interests of the agency. This accusation was made by several groups who watched the Energy Research and Development Administration's activities during the 1976 nuclear power referendum campaign in California.

Whether enough effort is being expended to make marine programs "visible" has been questioned from time to time. The lack of an "ocean constituency," that is, a public understanding of the importance of the ocean and its role in the economic, social, and strategic future of the Nation, has been cited as a problem which makes it difficult to seek support for ocean initiatives.[71]

Much of the impetus for more precollege marine education comes from these same concerns. What is not entirely clear, however, is whether lack of public attention to ocean matters is real, and if so, whether it is the result of insufficient Government effort, or a feeling among the public that ocean matters really are small in the grand scheme of national issues, or both.

At the same time, though, general public interest in the oceans has increased in recent years, as evidenced, for example, by the popularity of the Jacques Cousteau television specials, the National Geographic Society series, and by the amount of press coverage given to such ocean matters as the tanker accidents of the winter of 1977. Also, several recent innovative attempts have aimed to make the public more aware of the oceans and of Government programs. Two examples may give a flavor of these efforts.

One was the "oceans course by newspaper" effort of 1977. Entitled "Oceans: Our Continuing Frontier," this series of articles was carried by some 350 newspapers, and about 200 colleges and universities offered "Oceans" as credit and noncredit courses in conjunction with the newspaper series. The series covered literature and art as well as science and policy. It was produced by the University Extension, University of California at San Diego, with funding from the National Endowment for the Humanities.[72]

Second, NOAA's Office of Coastal Zone Management has a "coastal awareness program." It differs from traditional public information programs, because it not only distributes its materials, but also contracts with various groups to have them prepare information packages. To date, the League of Women Voters, the Natural Resources Defense Council, and several industry groups have been involved.

The Office of Coastal Zone Management also contains some of the newer programs oriented toward facilitating public participation. The Coastal Zone Management Act requires that States involve the public when developing their coastal zone plans, and the Federal office advises the States about developing both the information and organizational sides of their public participation programs. The Office also advises the general public about how to participate in coastal zone programs; this information is presented as part of the "coastal awareness program." Also, the Oceans Program of the Congressional Office of Technology Assessment has developed new ways to inform the public about policy issues and choices; OTA has a public participation project that carries on these activities.

Major Current Issues

In the future, several issues are likely to dominate discussions about general marine education and public information programs. In turn, resolution of these issues could affect significantly not only the Federal role in these areas but how much the public understands and supports ocean programs.

[71] U.S. Congress, Senate, Committee on Commerce, Science and Transportation. Nomination—Administrator, National Oceanic and Atmospheric Administration, Hearing before the Committee on Commerce, Science and Transportation, 95th Congress, 1st session, July 12, 1977, p. 91.

[72] George A. Colburn. "'Oceans: Our Continuing Frontier,' A National Oceanic Educational Program Prepared by Courses by Newspaper," in Marine Technology Society and Institute of Electrical and Electronics Engineers, *Oceans '77 Conference Report* 1: 11A-1 to 11A-3.

There probably will be no major issues dealing with the precollege training for those who will become marine specialists. There has been some controversy over the National Science Foundation's science education programs, and that may continue, but will not particularly affect marine science.

In general marine education, the major issue will continue to be what role the Federal Government should play, given, on the one hand, apparently increasing interest in the oceans and, on the other, not only traditional concerns about limiting the Federal role in education, but also present-day budget limitations. Proponents of a larger Federal role continue to encourage Sea Grant and the Office of Education to enlarge their marine education efforts, especially curriculum development, now that the two agencies have signed an interagency agreement highlighting the importance of the subject. Critics demand clear evidence of the need for a larger Federal role as well as detailed plans before supporting any significant new effort. Since large budget allocations are unlikely, the issue may focus on whether Sea Grant colleges should concentrate their limited general education funds on curriculum development or on hiring liaison people to work with State education departments.

While the basic concept of "public participation" increasingly seems to be accepted, in some cases even mandated by law, there is still controversy about what agencies should do to facilitate such participation. Debate about organizational arrangements will focus both on the structure for hearings, advisory committees, and so forth, and on the proper role for the environmental and public interest groups which claim to represent the public. Debate about the information side of agency programs is likely to focus less on the public's legal right to information and more on possible ways to help public groups find and use this information.

One present controversy that will continue is the question of whether NOAA should provide financial assistance to intervenors, enabling them not only to participate in hearings, but also to afford researchers and expert advisers, or whether, as some argue, the agency simply should improve public education and provide more information to special interest groups. If proponents of financial aid prevail, public participation will become more institutionalized in NOAA, though the agency will face the question of who is to be selected to represent "the public."

In any case, the very fact that this and similar debates now occur is further evidence of the changes and issues which now appear throughout the whole field of marine manpower and education.

Chapter IX: Organizing the National Ocean Effort

Introduction

In 1969, the year that *Our Nation and the Sea* was issued by the Stratton Commission, Federal ocean programs were located in 6 departments, 4 independent agencies, and 17 agencies or subagencies within the departments. Ocean programs in 1977 were administered by 9 departments, 8 independent agencies, and 38 agencies or subagencies (fig. 9–1 on pages IX–36 and IX–37).

Since 1972, Congress has enacted eight laws with major implications on ocean matters, including the Federal Water Pollution Coastal Act Amendments of 1972, the Marine Mammal Protection Act, the Marine Protection, Research and Sanctuaries Act, the Coastal Zone Management Act of 1972, the Endangered Species Act, the Deepwater Port Act of 1974, the Fishery Conservation and Management Act of 1976, and the Coastal Zone Management Act Amendents of 1976. The nature of this legislation emphasizes the management and conservation of the ocean and coastal resources, in contrast to legislative authority existing prior to 1970, which was largely directed toward providing ocean-related services, education, and marine science and engineering. This shift can be attributed in part to a change in the national mood in the early 1970s in which concern for environmental values came to the fore. Many of the legislative actions by Congress in the early 1970s dealing with ocean matters were designed to protect the marine environment or a component of it.

Failure of the United States to adopt an explicit "national ocean policy," the alleged lack of coordination among agencies administering ocean programs, and the absence of what advocates term an ocean commitment have been attributed to lack of a single ocean focus within the Federal structure. Although the National Oceanic and Atmospheric Administration (NOAA) was created by Reorganization No. 4 in 1970 in response to the recommendations of the Stratton Commission, it fell far short of the powerful comprehensive, independent ocean agency conceived by the Commission. While the center of civilian ocean activities is perceived by many to be in the Department of Commerce's NOAA, a major share of the actual functional activity is located in other line departments. In fact, the General Accounting Office (GAO) estimates that only 7.9 percent of the total Federal budget related to marine science activities and oceanic affairs during the period through 1974 was budgeted to NOAA.[1] At the same time, it has to be acknowledged that proliferation of related functions among Federal agencies is common. Many agencies have educational activities, many are involved in recreation or environmental protection, and many perform related research functions.

Whether the proposals for organizing around the ocean as a resource have merit must be evaluated in light of the increased use and importance of the ocean, the domestic and international economic setting, and the ranking of ocean resources and the ocean environment among other national priorities. Possible reorganization of the U.S. ocean effort must be considered in the context of other national goals.

Reorganization is essentially politics itself, and as such can be used to redistribute political influence, alter the substance of public policies, and signal the intention of the Government to place priority on a national goal. Creation of a Department of Energy was in part a statement by the current Administration of the importance it attaches to the topic. Although generally justified on the basis of increased efficiency and improved administration, reorganization is not necessarily the most promising means to achieve efficiency and reduce cost.[2] Therefore, the central question with regard to possible reorganization of ocean programs may depend less on the fragmented nature of ocean responsibilities among the Federal agencies, with the possible loss of efficiency, than upon the pragmatic question of: Is the ocean a sensible integrating theme around which to organize? And the corollary: Is the ocean important enough to justify reorganization? Also, are the deficiencies perceived in the administration of ocean-related programs best cured by reorganization or other means?

[1] U.S. General Accounting Office. *Federal Agencies Administering Programs Related to Marine Science Activities and Oceanic Affairs*, GGD–75–61, Washington, D.C., GAO, 1975, p. 3.

[2] Herbert Kaufman. "Reflections on Administrative Reorganization," in *The 1978 Budget: Setting National Priorities*, Joseph A. Pechman (ed.). Washington, D.C., Brookings Institution, 1977, p. 392.

This chapter discusses the organization of the Federal ocean program in the context of organizational theory, the importance of organization in developing effective "functional policy," the tradeoffs of reorganization, and the historical development of ocean-related Government organization, and includes an analysis of proposals that have been advanced to reorganize the Nation's ocean effort.

More Effective Administration: An Elusive Goal of Government

Trends in Governmental Organization

Since Congressman Albert Gallatin sought to enforce the limits of appropriations against the Secretary of the Treasury, Oliver Wolcott, in 1795, both the Congress and the President, like Diogenes in the quest for an honest man, have searched for better ways to conduct the business of Government.

Administrations for decades have sought to reorganize the executive branch for one or more of the following reasons: (1) to deal with specific problems, e.g., energy, housing, or social programs; (2) to improve efficiency and reduce waste; or (3) to recoup power from the bureaucracy. Congress, wherein the power to shape and form the Government resides (and from which the Presidency must obtain its comprehensive reorganizational powers), has also periodically sought reorganization for different reasons—often in dissatisfaction with the way the Executive Branch administers the laws.

The reports of the Dockery-Cockrel Commission (1895), Keep Committee (1909), Taft Commission (1913), Joint Committee on Reorganization (1923), Byrd Committee (1938), Brownlow Committee (1939), First and Second Hoover Commissions (1949 and 1955), and the Ash Council (1970) comprise the remains of earnest attempts to reorganize the executive branch.[3] Virtually every reorganization proposal heretofore has been based on the assumption that (1) administrative organizations should be structured by like functions and purpose, (2) overlapping functions should be minimized, and (3) control should be unified.[4]

Reorganization trends invariably lead to proposals for larger Cabinet-level departments as a strategy to unify control and consolidate authority. As a consequence, prescriptions for reorganization have suggested the creation of "superdepartments" with mixed constituencies that cut across the lines of statutory responsibility and congressional committee jurisdictions. While consolidation is the current vogue in Government organizations, a small number of commentators in public administration see the tendency toward bigness as a series of tradeoffs between: good policy-making on one hand and good management on the other; management by narrow objectives contrasted with the difficulty of having to respond to mixed constituencies, and flexibility of management being substituted by layered, hierarchial management.[5] Responding to broad constituency interests and to multiple congressional committees places added burdens on large composite organizations. On the other hand, smaller independent sub-Cabinet-level agencies are limited in effectiveness by: (1) potential for parochial response to narrow constituent groups; (2) inability to influence high-level policy decisions at the Cabinet level; (3) difficulties in coordinating policy among numerous small units; and (4) lack of critical mass to undertake large tasks in a comprehensive manner.

Clearly there is no panacea. Good organization—whatever form it may be—does not ensure successful policy and program execution, nor does poor organization preclude them. The key is to coalesce related functions into a unit of government that has a critical mass sufficient to influence high-level policy, yet is small enough to pursue identifiable objectives and flexible enough to adapt to changing needs.

The organization of government is in itself an art and not a science. The possible combinations and permutations for organizing governmental functions are almost infinite; moreover, organizational theory is of marginal value because of the reality of politics, the constraints imposed by governmental customs, traditional operating procedures, and established budgeting and accounting procedures. Like policy-making itself, the design of organizations must balance conflicting objectives. The appropriateness of organizational arrangements depends on the nature of the policy problems with which they must deal.[6] The question of atmosphere, setting, and environment in which the decisions and execution of policy are made is an oft-neglected quality of organization.

[3] U.S. Congress, Senate, Committee on Interior and Insular Affairs. Federal Energy Reorganization: Historical Perspective. 94th Con., 2d sess., Ser. 94–46, 1976.

[4] Peri E. Arnold. "Reorganization and Politics: A Reflection on the Adequacy of Administrative Theory." *Administrative Review* May–June 1974: 206.

[5] Warren G. Bennis. *Changing Organizations: Essays on the Development and Evolution of Human Organization.* New York: McGraw Hill Book Co., 1966. See also: J. C. Davies. "Reorganization of Federal Agencies." *Conservation Foundation* 20 October 1976, Washington, D.C.

[6] U.S. Commission on the Organization of the Government for the Conduct of Foreign Policy. Final Report, Organization for Foreign Policy, June 1975, p. 1.

Failure to recognize that executive administration is a political process as much as is enacting legislation tends to lull reorganizers into thinking of organization mechanically. In fact, administration has been referred to as the "eighth political process." [7] Reorganization is thus more than the mere drafting of uncluttered organizational charts.

It must also be recognized that no matter how the Government is organized, it is impossible to define and design programs in such a way as to eliminate all overlaps and potential conflicts among agencies—should that objective be considered desirable. At best, we can achieve no more than a less than optimal solution under any reorganizational scheme. Reorganization can even be counter-productive unless the net gains in efficiency offset the losses that inevitably result from reestablishing group dynamics, restructuring agency loyalties, and overcoming psychological impacts on personnel.

Although reorganization is ultimately aimed at changing the character and behavior of an organization, it can work in a negative manner by making change more difficult than it was before. If the net result of reorganization is to pile administrative echelon upon administrative echelon in an unremitting quest for coordination, symmetry, logic, and comprehensive order, the lines of communication may be stretched, morale lowered, and administrative entropy increased. Thus, there are negative factors associated with reorganization as well as positive potentials. Lest the result be a zero-sum game, the advantages and disadvantages must be weighed carefully. Because of this, reorganization is seldom implemented unless there is an obvious discontinuity or dysfunction in achieving a primary national goal. Of the eight attempts at wholesale reorganization of the Federal Government since the turn of the century, only incremental changes were made in each case, and those were generally in areas of major Government commitment, e.g., energy, housing, transportation, space, welfare, and environment. In other words, reorganization does not breed importance—importance breeds the need to reorganize.

The Trilogy of Organization

Too often reorganization of the executive branch is discussed as though governmental processes are an undifferentiated continuum from enactment of legislation through execution. There are actually three distinct executive functions to be considered: (1) formulation of policy, (2) implementation of programs, and (3) establishment of priorities. The first, *formulation of policy,* is centered in the White House within the executive branch. The second, *implementation,* involves execution by the agencies. The third, *priority,* is established by the budget process.

Government reorganization is most frequently discussed in the context of agency implementation, yet this might not be the weakest link in the chain of "functional policy." Ocean policy, for instance, is made at every step in the governmental process from enactment of legislation through administration of the programs in the field. The whole can be more than the sum of the parts. Each of the three governmental functions must be considered separately and jointly with respect to the effectiveness of the Federal Government in allocating the use of and protecting the Nation's ocean and coastal resources.

Nor can the linkages between the Congress be ignored in any organizational scheme. Congress both establishes policy through legislative authority and participates in setting priorities through appropriations. The evolution of objectives and the statement of purpose is requisite to the development of national policy and often results from spirited interaction between the Executive and the Congress. Organization of the Federal Government's administrative framework to pursue national goals is a responsibility shared by the President with the Congress, through its oversight and investigative activities, and is an important factor in ensuring the effectiveness of public policy. Budget requests and appropriations serve as indicators of relative priorities among ocean programs as well as between ocean activities and other budgetary items competing for finite Federal funds. In the aggregate, these three processes determine functional ocean policy.

Formulation of Ocean Policy

"Policy," by definition, is the goals, plans, and procedures of a government body. It embraces, therefore, both substance and procedure. Although the point of departure for developing national policy is the identification of "national goals," this is an optimistic concept that in reality seldom evolves as a conscious process. Although consensus on traditional values is common, agreement on specific policies that government should follow is extremely rare.[8] In the conventional sense, however, national ocean policy is set by the interaction of the legis-

[7] Paul Appleby. *Policy and Administration.* Montgomery: University of Alabama Press, 1949.

[8] Michael N. Davidson, Alan M. Hershy, and John M. Bayne. *One Nation, So Many Governments.* New York: Lexington Book, 1977, p. 141.

lative, executive, and judicial branches of the Federal Government through the identification of goals and the development of procedures and organizations to use the ocean's resources and protect its environment.

The United States, being a pluralistic society and operating through a representative government, is pursuing a number of sometimes conflicting, societal goals, simultaneously. Balancing the objectives of society is the essence of the political process. U.S. ocean policy is an integral part of legislative enactments dealing with natural resources, environment, national security, science and technology, energy, education, labor, marine transportation, and commerce. Our national ocean policy is complex and sophisticated and has not been, nor can it be, reduced to a simple statement of goals and procedures.

"National goals," although often referred to as if they are tangible items, are generally no more than broad, ambiguous generalizations. Goals are the wellspring of governmental policy and are derived from collective reasoning and public debate, often not in an institutional framework but in the value system of contemporary society. However, multiple goals often interact and even conflict with one another. Energy production and preservation of environmental values are frequently in conflict. Energy conservation and economic growth may similarly work in opposing directions unless the Gross National Product can be decoupled from energy use. Within the context of competing demands on the Federal budget, almost every goal is competing in some sense with a subset of related and unrelated goals for available funds. One need look no further than the goal of protecting certain coastal resources, weighed against the development of Outer Continental Shelf oil and gas, deepwater ports, water pollution control, ocean dumping, fishery management, and port development and use to be impressed with the close connection among these Federal resource management policies and the impacts they may have on each other.

The setting in which ocean policy is established under the present organizational system tends to favor diversity at the expense of consistency. With ocean programs scattered throughout more than 50 Federal governmental agencies, and with jurisdiction for ocean-related legislation shared by 39 subcommittees in 12 standing committees of the House of Representatives and 36 subcommittees in 10 standing committees of the Senate, the policy-making machinery is diffused in both the executive branch and the Congress.

To achieve consistency of purpose in public policy, however, there must be a mechanism to periodically review the course of governmental actions and analyze both the effectiveness and currency of the policies as well as the interactions of the various programs. The responsibility for this review is shared by both the Congress and the Executive, but neither have adequate means for reviewing and formulating comprehensive and consistent ocean programs at this time. The task is made even more difficult because ocean affairs range broadly from energy policy through environmental protection to international diplomacy. To ask for complete consistency would be to hold out false hopes. How the rational development of ocean policy and the maintenance of consistency among the Federal ocean programs can be ensured presents a major challenge to both the Congress and the President.

Role of the White House in Ocean Policy

Many observers in the ocean community believe that the White House should play a more active role in the development and oversight of ocean policy. These conclusions are based in part on the historical role that the Executive Office of the President has played in ocean affairs from time to time and in part on the concern that ocean matters do not receive sufficient attention on a consistent basis. Some also see what is perceived as a failure to coordinate the several Federal mission agencies which deal with disparate parts of ocean programs as a reason for White House intervention in the administrative process. These observers have to recognize, however, that all issue areas of national importance cannot and should not receive individual attention from special policy groups within the White House.

The prescription for a coordinating mechanism seems to take the same form whether dealing with oceans, poverty, science, telecommunications, or international and national security programs. The scenario follows a set pattern: (1) establishment of an interagency committee chaired by an agency head with no staff; (2) designation of a "neutral" chairman who is provided a staff; (3) transfer of coordinating functions to the White House or Executive Office of the President and reconstitution as a Presidential advisory council.[9] In the case of oceans, this circuit has been completed once and has started over again. The trend toward proliferation of special White House policy groups, which began with the creation of the National Security Council (NSC) shortly after the conclusion of the Second World War, was reversed by Reorganization Plan No. 1 of 1977 which eliminated nine of the specialized policy units in the Executive Office of the President,

[9] Harold Seidman. *Politics, Position, and Power.* New York: Oxford University Press, 1970, p. 165.

transferred the coordinative and operational functions of special units to mission agencies, and restructured those units which remained in the White House.[10]

Coordinating machinery is necessary only when coordination cannot be achieved by sound organization, good management, and formal and informal cooperation among agencies engaged in related and mutually supporting activities. Consolidation of programs through reorganization of the ocean effort within the responsible executive departments might improve coordination among ocean programs. However, the proponents of a White House-centered effort to oversee ocean affairs see benefits in the added stature and influence caused by association with the Executive Office of the President or the White House staff.

Historical Role of the White House in Ocean Policy

Marine Science Council

The National Council on Marine Resources and Engineering Development—known as the Marine Science Council—was created concurrently with the Stratton Commission by the Congress in 1966.[11] The Council was established as a temporary Cabinet-level interagency group in the Executive Office of the President. The Vice President was chairman as designated by statute and had the responsibility to develop and advance a comprehensive program dealing with all aspects of marine science activities. Under the chairmanship of Hubert H. Humphrey, the Council was visible, and according to observers, at least partially successful and active in exercising leadership in ocean science and technology policy. However, 3 months before its expiration, the authorizing legislation for the Council was terminated in 1971 allegedly for "lack of interest" of the Administration at that time.[12]

Since then, ocean science policy coordination has been relegated to lower sub-Cabinet level interagency coordinating committees of various kinds. The reporting requirement of the Marine Resources and Engineering Development Act continues to be fulfilled annually under the auspices of the Federal Council for Science and Technology with the assistance of various science-related policy groups that have tended to appear and disappear over time. First, the Office of Science and Technology (OST), then the Science and Technology Policy Office of the National Science Foundation (NSF), and currently the Office of Science and Technology Policy (OSTP).

Title I of the Marine Resources and Engineering Development Act, the authority for both the Marine Science Council and the Stratton Commission, is essentially dormant although it still remains in the U.S. Code. The declaration of ocean policy for the nation in the 1966 act does remain, although ignored by most and bypassed by subsequent events. It reflects the emphasis at the time of passage of the Act on the potential seen in using ocean resources. The policy objectives emphasize accelerated development, encouragement of private enterprise in ocean resource use, and development of technology for various ocean uses. Resource protection is not mentioned.

The only remaining vestige of the policy focus on marine science is the report mandated by the Act, titled *Federal Ocean Programs*. The document reflected the status of ocean activities in the Federal Government when produced by the staff of the Marine Sciences Council, but since then has diminished in quality and quantity and has been released as much as a year-and-one-half beyond the required statutory date. For several years, the *Federal Ocean Programs* report has been compiled piecemeal as an interagency effort rather than by an integrated staff. Its contents vary in quality among the sections, little marine science policy guidance is provided in the document, and its usefulness is impaired by the uneven treatment given the sections by agencies that clearly consider it to be an onerous chore. The White House has shown little concern for the report, which helps explain the extended delays in its issuance.

Science Advisory Structure

At one time marine science and technology were the major focus of ocean policy. Subsequent to the spectacular space achievements of the Russians in the late 1950s, Federal priorities were shifted to space technology. Other scientific areas, including oceanography, were also the beneficiaries of the major emphasis on science. Thus, the Stratton Commission and the Marine Science Council which were created during the "grand period of science" were similarly oriented toward research and development. Before the establishment of the Marine Science Council, there were efforts in the 87th Congress in the early 1960s to give the then-existing Office of Science and Technology (OST) responsibility for presiding over a coordinated national program of oceanography to be aided by an Advisory Committee on Oceanography. It is not surprising, therefore, that the science advisory functions within the Executive

[10] U.S., President, "Presidential Message to the Congress Transmitting Reorganization Plan No. 1 of 1977," 18 July 1977. *Presidential Documents*, 13:1007–1016.

[11] Marine Resources and Engineering Development Act, 33 U.S.C. 1101–1108.

[12] Edward Wenk, Jr. *The Politics of the Ocean*. Seattle: University of Washington Press, 1972, p. 163.

Office of the President have significantly influenced national ocean policy over the years.

A special assistant to the President for Science and Technology was appointed, and in March 1959 the Federal Council for Science and Technology (FCST) was formed, followed by the creation of the Interagency Committee on Oceanography (ICO) within the FCST. The expression of interest by the Administration in ocean science and technology has been cited by commentators as the catalyst which prompted the Congress to create formally the Marine Science Council in 1966. A bill to this effect was pocket-vetoed upon adjournment of the 87th Congress, allegedly for administrative rather than substantive reasons.

With the termination of the Marine Science Council in 1971, the responsibility for marine science oversight within the Executive Office of the President was shifted to the Office of Science and Technology (OST) until its dismantlement in 1973. Since that time, and until the creation of the Office of Science and Technology Policy in 1976,[13] the Executive Office of the President was without in-house counsel for marine science and ocean affairs. During the interim, the science advisory role was served by the Director of the National Science Foundation (NSF), through the staff of the Science and Technology Policy Office. However, that Office had no special unit to track the developments in ocean science policy.

Present White House Policy Organization

Policy Councils

The policy formulation system within the White House generally reflects the style and character of the President. Some Presidents have relied on the advice of cloistered associates, others have developed a collegial atmosphere among Cabinet members, and some prefer to rely on staff analysis and trusted senior staff within the White House for policy guidance.

However, each modern President has inherited a number of special policy councils that have been established in the Executive Office of the President by statute, reorganization plan, Presidential memorandum, and executive order. Before Reorganization Plan No. 1 of 1977, under which the Executive Office of the President was restructured, 19 policy units dealt with general and specialized issue areas. Nine of these units were eliminated by the Reorganization Plan and earlier executive action.

Before reorganization, various aspects of ocean policy were considered by four Cabinet-level councils that were responsible for formulating general policy: (1) Domestic Council, (2) National Security Council, (3) Energy Resources Council, and (4) Council on International Economics Policy. In reality, these entities operated less like true councils in the sense of collegial decisions being made through interaction among Cabinet officers and more like specialized staff operations, but the councils did serve as a forum for resolving conflicts among competing domestic, international, economic, and energy policies.

Reorganization Plan No. 1 eliminated both the Energy Resources Council and the Council on International Economics Policy. The Domestic Council's functions were melded into a Domestic Policy Staff within the White House Office and given responsibility for managing the processes that coordinate the development of domestic and economic policy. The National Security Council (NSC), which was created by the National Security Act of 1947 (50 U.S.C. 402), remains as originally constituted. Its function is to advise the President with respect to the integration of domestic, foreign, and military policies related to national security.

This new system of policy integration within the White House places the responsibilities for coordinating ocean policy upon the Domestic Policy Staff and the National Security Council. Additional input to policy formulation comes from the Office of Science and Technology Policy and the Council on Environmental Quality, which reside in the Executive Office of the President.

Emphasis of the new policy process and organization in the White House is placed on Presidential decision-making. The departments and agencies must, therefore, assume the major responsibility for reviewing the state of ocean policy on a continuing basis and provide policy initiatives for consideration by the White House. This places an added burden on the White House staff to ensure that agency efforts are properly coordinated and evaluated.

The Presidential decision-making process will use a system of Presidential Review Memorandum (PRM) similar to that which has been developed by the National Security Council. The PRM process is a mechanism for developing a decision document through interaction of the White House staff and the agencies. It is an interactive process that uses interagency working groups coupled with staff input to produce a decision memorandum upon which the President can implement policy directions through directives and other appropriate means. The process described in figure 9–2 would be used for the most complex policy issues. An abbreviated version of the PRM process will normally be used for less complex policy decisions. The President plays an

[13] National Science and Technology Policy, Organization, and Priorities Act of 1976, 42 U.S.C. 6601 et seq. (Supp. 1976).

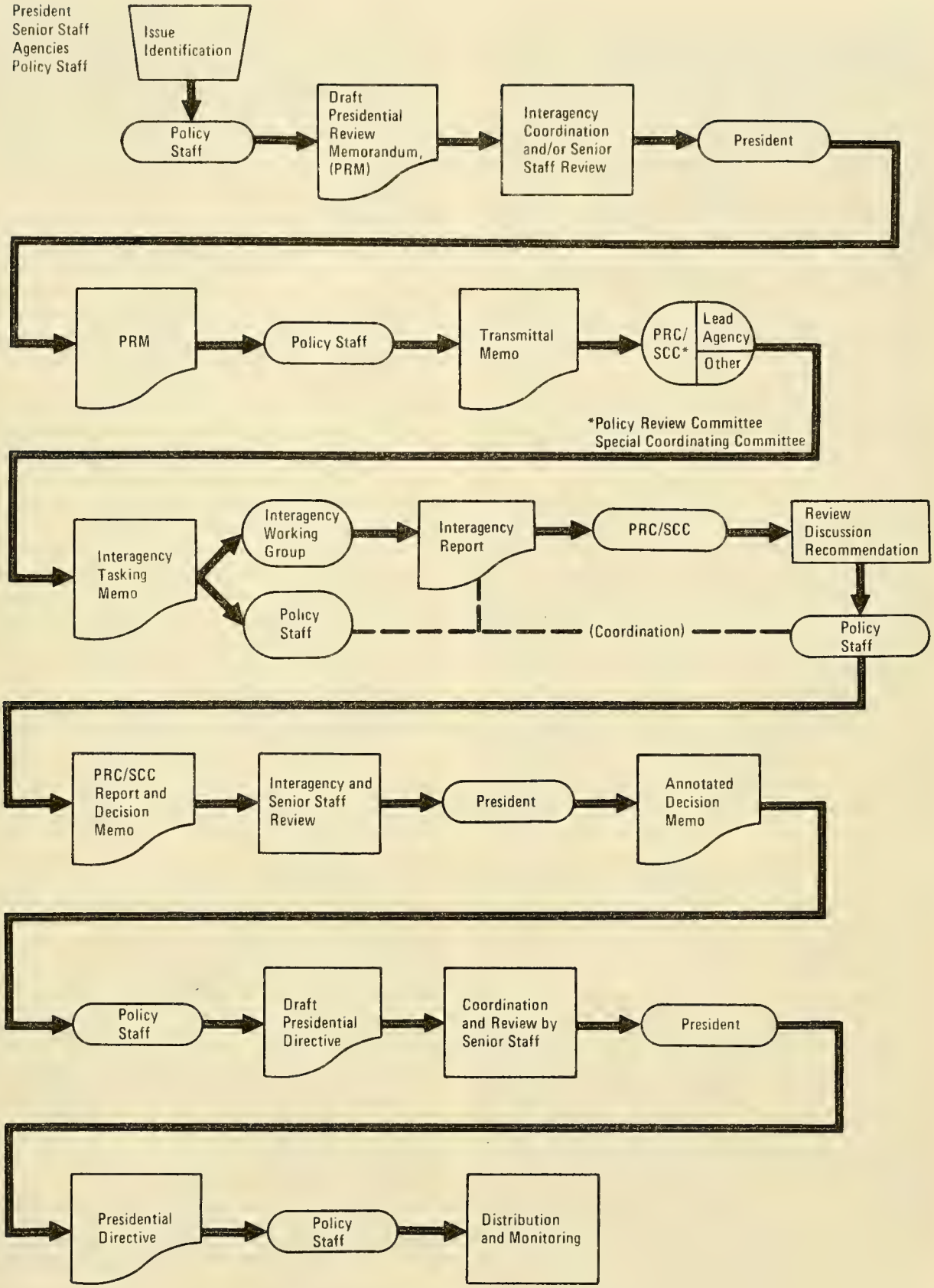


Figure 9–2.—Policy Staff management system.

integral part of the PRM process from beginning to end. To this extent, the Presidential Review Memorandum serves as a means to develop a working knowledge of the issue under review in advance of the final decision. The success of the PRM process will depend on the skill of the White House staff in organizing and directing the interagency efforts. The performance record of interagency task groups is mixed, at best. Strong leadership is required to overcome the potential for interagency conflict and posturing.

The four-Council system that operated during the period 1970 through 1977 was criticized for its lack of focus on specific ocean problems. The overlap in Cabinet membership among the Presidential councils, which resulted in redundancy and cross-membership, was considered a strength of the system by some because the same Cabinet Officers and advisors were required to approach common problems from different points of emphasis—domestic, international, economic, and national security.[14] To the extent that the former system encouraged cross-fertilization in the development of ocean policy, the new system of staff integration and NSC review must engender the same multifaceted thinking in the PRM process. The strength of the new Domestic Policy Staff/NSC decision system is its ability to deal with individual issues in a comprehensive manner and present well-reasoned and well-researched options to the President for final consideration.

The National Council on Marine Resources and Engineering Development (Marine Science Council), which was abandoned in 1971, was basically similar to the model of the National Security Council. During its operation, the Council provided a focus on ocean science policy objectives. The National Security Council differs from the defunct Marine Science Council in that NSC considers foreign and domestic issues in light of its overriding concern for national security and foreign affairs. Cabinet-level representation on the NSC is limited to the Secretary of State and the Secretary of Defense.

Office of Science and Technology Policy

With the dismantling of the science advisory structure within the White House in 1973, there was a hiatus in top-level concern over science policy. While the director of NSF served in the capacity of Science Advisor, his remoteness from the President's office and lack of access reduced his effectiveness in influencing White House policy, according to some observers. Furthermore, no specific ocean science and technology effort was developed within NSF for oversight of ocean science policy.

Enactment of the National Science and Technology Policy, Organization, and Priorities Act of 1976[15] by the 94th Congress reinstated a science policy mechanism within the Executive Office of the White House. The Office of Science and Technology Policy (OSTP), which was established by the Act and whose operations were subsequently modified by Reorganization Plan No. 1, is responsible for providing input to the Presidential decision-making process for science policy and budget decisions. The three advisory and coordinating bodies established by the Act—the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP); the President's Committee on Science and Technology (PCST), which was charged by the Act with examining and analyzing the entire Federal R&D effort, including ocean science and technology; and the Federal Coordinating Council for Science, Engineering and Technology (FCCSET)—were altered by Reorganization Plan No. 1 of 1977. In lieu of FCCSET, which served briefly as the umbrella organization for the ocean-related interagency coordinating activities, the Committee on Atmosphere and Oceans (CAO), was reconstructed as a sub-Cabinet working group chaired by the science advisor. CAO incorporated functions of the former Interagency Committee on Marine Science and Engineering (ICMSE) and the Interagency Committee on Atmospheric Sciences (ICAS). ICMSE had served as a sub-Cabinet level coordinating committee to improve communication among the ocean-related agencies. It was chaired throughout its 6-year history by the administrator of the National Oceanic and Atmospheric Administration. ICMSE served as an interagency forum with a focus on marine science and technology and was a coordinating body, but it played no formal advisory role in the development of ocean policy within the White House.

The director of the Office of Science and Technology Policy serves as the President's science advisor for a broad range of science-related governmental issues. The assistant director for Natural Resources and Commercial Services is responsible for the activities within OSTP concerning marine science and technology. Given the active role that the science advisory structure has played in the development and articulation of ocean policy, it is anticipated that the OSTP will assume responsibility for continuing the analysis and development of ocean-related R&D policy.

Council on Environmental Quality

The Council on Environmental Quality (CEQ) was established by the National Environmental Policy Act of 1969 (NEPA) to formulate and recom-

[14] U.S. Congress, House, Committee on Merchant Marine and Fisheries. National Ocean Policy, Hearing before Subcommittee on Oceanography. 94th Cong., 2d sess., Ser. 94–43, 1976, p. 7.

[15] National Science and Technology Policy, Organization, and Priorities Act of 1976, 90 Stat. 459.

mend national policies for improving the quality of the environment.[16]

CEQ consists of three members appointed by the President with the advice and consent of the Senate and was modeled after the Council of Economic Advisors which was created by the Employment Act of 1946. The Council and its support staff are attached to the Executive Office of the President. The advisory role of CEQ is aimed at providing independent assessment of environmental policy. Emphasis is placed on analysis of long-term trends and conditions in the environment. Based on such analyses, the Council develops and recommends to the President national policies to protect and enhance the quality of the environment.

CEQ differs from the prototype of other policy councils within the White House policy advisory structure in that the three members of the Council are full-time appointees like the Council of Economic Advisors, rather than representatives of the executive departments and agencies. This serves to insulate the Council from parochial views born of vested interests in organizational attitudes. It casts the Council in the role of honest broker. Its effectiveness as a coordinating mechanism depends largely on the skill and ability of the Council and its staff in persuading the mission agencies to pursue policies which will ensure adequate protection of the environment. Its influence is proportional to the emphasis that the President, and consequently the White House staff, places on CEQ's advice.[17]

The broad environmental mission of the Council involves it in virtually every governmental program dealing with natural resources and energy. As a consequence, CEQ has devoted considerable attention to matters affecting the marine and coastal environments. It has dealt with issues involved in OCS oil and gas leasing both onshore and offshore, ocean pollution questions and coastal zone management.

In the past, CEQ has had considerable influence over the functional environmental policy of the agencies through the review of environmental impact statements required by Section 102(2)(C) of the National Environmental Policy Act. Reorganization Plan No. 1 of 1977, however, transferred the responsibility for review of the adequacy of agency impact statements to the Environmental Protection Agency (EPA), thereby eliminating the most direct leverage that CEQ had to influence functional policy. However, CEQ will continue to assert its opinions on the quality and substance of the individual impact statements.

Because of the complexity and interactions involved in the White House policy process, it is impossible to accurately evaluate the effectiveness of CEQ as a policy-formulating body. To the extent that CEQ's track record has been evaluated, its weaknesses in the policy process have been ascribed to: (1) the limited size of CEQ, which has compelled it to concentrate on immediate problems at the expense of comprehensive, long-range policy; (2) absence of mission-agency authority to direct and implement policy; and (3) lack of control over development and initiation of legislative environmental initiatives.[18]

Implementation of the presidential review memorandum process as a component of the White House policy staff management system may provide a more even-handed and less adversary atmosphere in which CEQ can play a significant role in formulating ocean policy with regard to protection of the marine environment.

Ocean Policy Unit for the White House: An Enduring Proposal

The quest for an improved process for developing and assessing national ocean policy repeatedly leads back to proposals for recreating a Cabinet-level White House policy unit to oversee ocean affairs. Between 1966 and 1971 the National Council on Marine Resources and Engineering Development—known as the Marine Science Council—served as a focus for national ocean science policy.[19]

The Marine Science Council was as much a symbol of national commitment to the oceans as it was an effective policy mechanism. It existed during a period of rapid growth in the budget for ocean research and development. Since termination of the Council in 1971, ocean policy, including marine science, has been determined in the context of functional problems within the framework of the domestic and foreign policy councils remaining in the White House. Coordination, on the other hand, has been relegated to the Interagency Committee on Marine Science and Engineering (ICMSE), which up to its recent abolition provided a modicum of coordination through committee communications, but served no formal policy-making role. Thus a symbol of national commitment to a comprehensive ocean program has not existed in the White House since 1971. Some maintain that such a symbol is not needed and that ocean issues can be successfully dealt with as they arise or are perceived within the present decision structure. There is little disagreement among observers that during the interim, 1971 through 1976, the Congress has taken the initiative

[16] National Environmental Policy Act of 1969, 42 U.S.C. 4321 et seq.

[17] U.S. Congress, Senate, Committee on Interior and Insular Affairs. The Council on Environmental Quality—Oversight. 94th Cong., 2d sess., 1977, p. 34.

[18] Ibid., p. 42.

[19] Marine Resources and Engineering Development Act, 33 U.S.C. 1101–1108.

in determining the course of U.S. ocean policy. A detailed discussion of the role of Congress in development of ocean policy, as well as its organization for dealing with ocean questions, is beyond the scope of this discussion.

The need seen by some for policy direction at the Presidential level has prompted a number of suggestions that an institution similar to the former Marine Science Council is again needed within the Executive Office of the President.[20] To succeed, such proposals must demonstrate that there are significant issues requiring the attention of the President that are not adequately handled now. These specific proposals have been advanced in recent years—two in the form of legislation, and another as an academic concept—which would reinstate a policy council in the Executive Office of the President: (1) A National Council on Marine Science, Engineering, and Resource Development (S. 709, 94th Cong., Senator Humphrey H. Humphrey), (2) A Marine Affairs Council (Professor John Norton Moore, 1976) and, (3) an Office of Maritime Affairs Coordinator (S. 3580, 94th Cong., Senator Robert Taft, Jr.).

Marine Science or Marine Affairs Council

Senator Hubert H. Humphrey, the first chairman of the former Marine Science Council by virtue of his tenure as Vice President during its existence, introduced S. 709, the Marine Science, Engineering, and Development Act of 1975, which proposed to establish a National Council on Marine Science, Engineering, and Development along with a coordinative advisory panel. Like the Marine Science Council, the proposed council would be a Cabinet-level group chaired by the Vice President. Authority would be provided for employing a professional staff under the direction of an executive secretary to be compensated at a level not to exceed Executive Level II.

The responsibilities of the proposed council under the Humphrey proposal would include:

- Survey significant marine science activities.
- Develop a comprehensive long-range program of marine activities.
- Evaluate the conduct of the Federal marine science activities.
- Insure cooperation and resolve differences among Federal departments and agencies.
- Undertake comprehensive study of marine-related legal problems.
- Study benefit/cost of marine resources, engineering, and science to the United States.
- Review all marine service activities annually.
- Administer a grant program to foster participation in the overall Government marine program.

The Humphrey proposal, if enacted, would constitute in effect a reenactment of the Marine Resources and Engineering Development Act of 1966, since S. 709 and the Act differ only in detail. A principal difference would be the creation of an Advisory Panel on Marine Science, Engineering, and Resource Development proposed by S. 709 which would incorporate the National Advisory Committee on Oceans and Atmosphere (NACOA), supplemented by congressional members, to review and make recommendations on ocean affairs to the council. The statutory mandate of NACOA would remain unaffected. S. 709 also would reinstate the responsibility for publishing a detailed report of national marine programs—the report prepared through the science advisory structure and ICMSE since 1971.

The emphasis placed on marine science and technology in the Humphrey proposal contradicts, to some extent, the developing consensus that national ocean policy transcends the once-popular concept that marine science and engineering is the umbrella for all ocean policy. While the implied focus of the council proposed by S. 709 is weighted toward science and engineering, there would probably be no legal constraints for such a council, if staffed by aggressive professionals, to confront problems extending beyond the traditional limits of marine science and technology.

Professor John Norton Moore proposed the creation of a Marine Affairs Council as part of a comprehensive plan to reorganize the Federal ocean effort.[21] The Marine Affairs Council, a variation of the Marine Science Council concept, would similarly be chaired by the Vice President and serve as a Cabinet-level forum for developing and coordinating national ocean policy. Its coordinative functions would be executed through an Interagency Task Force on Oceans Policy chaired by the Executive Director of the Marine Affairs Council, who would be supported by a professional staff. Reflecting the broader reorganization thrust of the Moore proposal, the Marine Affairs Council would deal with maritime transportation policy and merchant marine affairs in addition to what is customarily considered ocean policy.

Office of Maritime Affairs Coordinator

Maritime transportation has generally been treated in isolation from other ocean policy issues. It has been considered primarily as an economic tool of

[20] Edward Wenk, Jr., op. cit. note 12, p. 200 et seq. See this reference for an analysis of the role played by the Marine Science Council in formulating and advancing such legislative concepts.

[21] John Norton Moore. "The Crisis in Ocean Policy: Time for Change." *Marine Technology Society Journal* 10 October–November 1976: 3–10.

commerce and secondarily as a factor in national security. The maritime statutes, primarily the Merchant Marine Act of 1936 and amendments, are administered by the Maritime Administration (MarAd) within the Department of Commerce.

The national security element of U.S. maritime policy is vital to the Nation's defense posture. Lines of communication are necessary to project power to potential points of conflict throughout the world. It is questioned by some experts and Government officials whether the current status of the merchant marine could support the logistics of a major military action.[22] The merchant marine also supports defense activities in peacetime and may play an expanded role in such areas as towing and salvage.

In June 1976, the Transportation Institute, an organization representing U.S.-flag carriers, released a study in which it defined the need for beter coordination of maritime and defense affairs.[23] The study recommended creating the post of "Maritime Affairs Coordinator," which would be responsible for (1) establishing and developing specific legislation for a national maritime strategy; (2) coordinating U.S. maritime research programs; (3) designing and coordinating an overall naval-merchant shipbuilding program, and (4) ensuring adherence to the provisions of the various existing laws relating to domestic and foreign trade, and increasing the merchant marine's support of national defense objectives.

Senator Robert Taft, Jr.—who was the author of a white paper on defense in which he identified the Navy's need for cargo ships, oilers, and ammunition ships in the context of the U.S. Merchant Marine [24]—introduced S. 3580 in the 94th Congress, a proposal to establish an Office of Maritime Affairs Coordinator in the Executive Office of the President. Patterned after the recommendations of the Transportation Institute, the office would be directed by a maritime affairs coordinator, who would serve as a member of the National Security Council. Membership in the NSC, according to the proposal, would provide for the maritime industry's input to national defense matters. The present membership of NSC is restricted to the Departments of State and Defense. The Maritime Affairs Coordinator proposed by S. 3580 would:

- Develop and recommend to the President and the Congress a national maritime strategy program, including a civil-military shipbuilding program, and necessary legislation to effectuate such program.
- Coordinate all Federal civil and military maritime research programs.
- Coordinate all other Federal maritime activities and make appropriate recommendations to insure adherence to the provisions of existing laws relating to domestic and foreign trade.
- Represent maritime interests in national transportation planning.

If the Office of Maritime Affairs Coordinator were modeled after the prototype recommended by the Transportation Institute, the maritime affairs coordinator would work directly with the following agencies to insure coordination of national naval-maritime interests: (1) Navy, (2) Coast Guard, (3) Maritime Administration, and (4) National Oceanic and Atmospheric Administration. The coordinator also would conduct continuous liaison with other Government agencies, as appropriate (e.g., Department of State, Department of Defense, and the Office of Management and Budget), and the relevant executive committees. Under the proposal, however, the Office of the Maritime Affairs Coordinator would be an advisory/consultative organization and would neither preempt nor directly affect the line responsibilities of MARAD for administering the maritime programs authorized under the maritime acts.

White House Councils: Concept in Perspective

The need for a White House Council to formulate and coordinate ocean policy at the highest level of the executive branch is considered to be axiomatic by most in the ocean community. The persistence of the concept is attributable to the logical rationale of the proposal, the perceived success of the former Marine Science Council, and faith that presence in the White House will assure commitment and direction in Federal ocean policy.

Whether a White House Council would meet the expectations of the ocean community, however, depends upon a subset of external considerations. First, there is little chance that such a council which is ordained by the Congress would be influential unless the President fully concurred in its creation or unless it was formed at his initiative. White House councils are of limited value if they deal with subject areas that are not perceived as crucial by Presidents. Second, Stephen Hess points out that the use of the Vice President for chairing advisory councils runs the risk that the President may ultimately have to reject the advice of his Vice Presi-

[22] U.S. Congress, House, Committee on Merchant Marine and Fisheries. National Ocean Policy, Hearings before Subcommittee on Oceanography. 94th Cong., 2d sess., Ser. 94–43, 1976, p. 35, Testimony of William Middendorf III, Secretary of the Navy.

[23] Transportation Institute. *An Analysis of the Direct Impact of the Merchant Marine on National Security.* Washington: Transportation Institute, 1976.

[24] Robert H. Taft, Jr., assisted by William S. Lind. White Paper on Defense: A Modern Military Strategy for the United States (processed). Washington: 1976.

dent publicly, thereby risking the appearance of discord within the Administration.[25] Third, the relative success of the Marine Science Council, which has been used as a model for proposed new organizations, must be reexamined carefully to determine its functional effectiveness. Edward Wenk's *Politics of the Ocean* remains the only analysis of the performance of the Council. Notwithstanding this scholarly analysis, the Council and its counterpart, the Stratton Commission, were riding the crest of a wave during a period of faith in science; thus, the cause and effect of what transpired in Government during that period is difficult to assess objectively. The frailty of the Council as an institution, however, is well documented by Dr. Wenk, who shows that it was wholly dependent upon the initiative of the Vice President and the receptivity of the President to ocean programs.[26]

Trends in the Carter Administration are contrary to the concept of centralizing power in the Executive Office of the President. Noting that the tendency in the past has been to put programs that cut across many departmental lines in the Executive Office on the theory that "the closeness of the President is supposed to add stature to their influence and . . . permit them to deal with several departments simultaneously," President Carter has moved to reduce policy council and special coordinative units in an effort to "strengthen Cabinet government."[27] President Carter has, therefore, opted for a collegial Cabinet approach to guiding and managing national policy. In moving to abolish all Cabinet-level policy councils save the National Security Council (NSC), proposals for a White House policy council to oversee ocean affairs or maritime policy are not in keeping with present reorganizational trends.

Advisory Committees

Federal advisory committees have proliferated during recent years. In the quest for public participation in the governmental decision process, departments and agencies have created many general and specialized advisory groups to counsel administrators on the execution of government programs. At the end of calendar year 1976, there were 1,159 committees in existence, involving 27,000 persons and costing $59.7 million.[28] Of these advisory committees, councils, and commissions, 75 dealt with ocean-related matters (table 9–1). Advisory committees are widely used within the executive branch at all levels of administration. To some extent they have become a symbol of participatory democracy, and have been skillfully used by some public administrators to dull the edge of criticism of "closed decision-making." There are, unfortunately, no objective measures of the effectiveness of advisory committees since the policy agenda is formed from diverse participants over an indefinite time span. Some advisory committees, however, serve a higher order of purpose and play a significant role in providing insights and policy options for highly complex and technical areas of policy to the President and the Congress.

National Advisory Committee on Oceans and Atmosphere

One such committee is the National Advisory Committee on Oceans and Atmosphere (NACOA), created by the Congress in 1971 to provide advice to the President and the Congress on national marine and atmospheric affairs.[29] The original NACOA Act, which was adopted in response to recommendations by the Commission on Marine Science, Engineering, and Resources (Stratton Commission), in 1969,[30] was repealed by the 95th Congress and reconstituted with 18 members instead of the original 25.[31]

Members of the Committee are appointed by the President, and under the new authorizing legislation must be qualified by knowledge and expertise in marine or atmospheric affairs. NACOA, therefore, is more accurately characterized as a "blue-ribbon" committee than as a citizen advisory committee as used in common parlance.

NACOA serves as a comprehensive oversight committee for all Federal ocean and atmospheric programs. While the enabling legislation explicitly requires NACOA to serve as an advisory body to the National Oceanic and Atmospheric Administration within the Department of Commerce, its broader legislative mandate makes it advisory to both the legislative and executive branches. The Committee is housed within the Department of Commerce, although it operates entirely independently with its own staff and budget authorization. Under the Act, NACOA's responsibilities are to:

- Undertake a continuing review of national ocean policy, coastal zone management, and the status

[25] Steven Hess. *Organizing the Presidency*. Washington: Brookings Institute, 1976, p. 186.
[26] Edward Wenk, Jr., op. cit. note 12, p. 163.
[27] U.S., President, "Remarks to Reports on Transmitting a Reorganization Plan to the Congress." 18 July, 1977. *Presidential Documents* 13: 1007.
[28] U.S. General Services Administration. *Federal Advisory Committees—Fifth Annual Report to the President*. March 17, 1977, pp. 1–2.
[29] 33 U.S.C. 857–6 to 857–12; amended in the 94th Congress, Public Law 94–69, 89 Stat. 384.
[30] Report of the Commission on Marine Science, Engineering, and Resources to the President of the United States and the U.S. Congress, by Julius A. Stratton, Chairman. *Our Nation and The Sea—A Plan for National Action*. Washington, D.C., Government Printing Office, 1969. p. 245.
[31] National Advisory Committee on Oceans and Atmosphere Act of 1977, Public Law 95–63, 91 Stat. 265.

Table 9–1.—Federal advisory committees, commissions, and councils related to ocean affairs

Presidential Committees, Commissions, and Councils
Council on Environmental Quality
Marine Mammal Commission
National Advisory Committee on Oceans and Atmosphere
National Transportation Policy Study Commission
United States Water Resources Council

Department of Commerce
Advisory Board to United States Merchant Marine Academy
Caribbean Fishery Management Council
- Advisory Panel for the Caribbean Fishery Management Council
- Scientific and Statistical Committee

Coastal Zone Management Advisory Committee
Gulf of Mexico Fishery Management Council
- Billfishes/Pelagic Sharks Advisory Council
- Groundfish Advisory Council
- Migratory Coastal Pelagic Fishery Advisory Panel
- Reef Fish Advisory Panel
- Scientific and Statistical Committee
- Shallow Water Shrimp Fishery Advisory Panel

Marine Fishery Advisory Committee
Mid-Atlantic Fishery Management Council
- Scientific and Statistical Committee

New England Fishery Management Council
- Scientific and Statistical Committee

New York Bight MESA Advisory Committee (Marine Ecosystems Analysis)
North Pacific Fishery Management Council
- Advisory Panel for the North Pacific Fishery Management Council
- Scientific and Statistical Committee

Pacific Fishery Management Council
- Anchovy Advisory Panel
- Groundfish Advisory Panel
- Jack Mackerel Advisory Panel
- Sablefish Advisory Panel
- Salmon Advisory Panel
- Scientific and Statistical Committee

Sea Grant Review Panel
South Atlantic Fishery Management Council
- Scientific and Statistical Committee

Western Pacific Fishery Management Council
- Scientific and Statistical Committee

Department of Defense
Naval Research Advisory Committee
Shoreline Erosion Advisory Panel
Underwater Sound Advisory Committee
U.S. Army Coastal Engineering Research Board

Department of the Interior
Canaveral National Seashore Advisory Commission
Cape Cod National Seashore Advisory Commission
Gateway National Recreation Area Advisory Commission
Golden Gate National Recreation Advisory Commission
Gulf Islands National Seashore Advisory Commission
Indiana Dunes National Lakeshore Advisory Commission
Outer Continental Shelf Advisory Board
Outer Continental Shelf Environmental Studies Committee
Pictured Rocks National Lakeshore Advisory Commission
Sleeping Bear Dunes National Lakeshore Advisory Commission

Department of State
Advisory Committee on the Law of the Sea
Advisory Committee to the United States National Section of the International Commission for the Conservation of Atlantic Tunas
Advisory Committee on the United States Section of the Inter American Tropical Tuna Commission
Advisory Committee to the United States Section, International North Pacific Fisheries Commission
Ocean Affairs Advisory Committee
Shipping Coordinating Committee

Table 9–1.—Federal advisory committees, commissions, and councils related to ocean affairs (continued)

Department of Transportation
Coast Guard Research Advisory Committee
National Boating Advisory Council
New York Harbor Vessel Traffic System Advisory Committee
Rules of the Road Advisory Committee
Saint Lawrence Seaway Development Corporation Advisory Board
Ship Structure Committee
Towing Industry Advisory Committee

Environmental Protection Agency
Science Advisory Board

Federal Communications Commission
Radio Technical Commission for Marine Services
RTMC Special Committee No. 69/WARC (World Administrative Radio Conference) Advisory Committee for Maritime Mobile Service

National Aeronautics and Space Administration
Ocean Dynamics Advisory Subcommittee

National Science Foundation
Advisory Committee for Division of Atmospheric Sciences
Advisory Committee for Division of Earth Sciences
Advisory Committee for Division of Environmental Biology
Advisory Committee for Division of Ocean Sciences
Advisory Committee for Division of Polar Programs

Marine Mammal Commission
Committee of Scientific Advisors on Marine Mammals

of the marine and atmospheric science and service programs;
- Advise the Secretary of Commerce with respect to the carrying out of the programs administered by the National Oceanic and Atmospheric Administration;
- Submit an annual report to the President and the Congress setting forth an assessment of the status of the Nation's marine and atmospheric activities; and
- Submit such other reports as may be requested by the President or the Congress.

NACOA has submitted six annual reports. Emphasis changes from year to year, however, NACOA has reviewed and made recommendations concerning fisheries, coastal zone management, Law of the Sea, marine transportation, marine science and engineering, and reorganization of Federal ocean programs. Special reports have been issued on the Sea Grant Program, ocean engineering and other subjects requested by the Congress and the Executive. NACOA has concentrated on evaluating Federal programs within the executive branch, although it has also dealt with legislative questions.

Seidman has observed that "what the Government basically wants from advisory committees is not expert advice, . . . but support." [32] Advisory committee members frequently act as program missionaries and serve as a kernel of grass-roots support for mobilizing efforts to influence Congress and promote a program within the executive branch. Because specialized advisory committees have the potential for representing special interests at the expense of the general interest of the public, the impact of advisory committee recommendations is substantially undermined.

[32] Harold Seidman, op. cit. note 9, p. 239.

National Academies of Sciences and Engineering

The quasi-governmental committees operating under the National Academies of Sciences (NAS) and Engineering (NAE) through the National Research Council (NRC), although not official governmental advisory bodies, stand in a special relationship to the Government because of the stature of their membership. Membership in the academies is by peer election from among distinguished members of the science and engineering disciplines. The National Research Council (NRC) was organized as a subsidiary to the academies in order to broaden the representation among scientists and technologists in the furtherance of science and technology for the benefit of the public. Participation in NRC studies and panels does not require membership in the NAS or NAE as a prerequisite. NRC has become the operational arm for the NAS/NAE, while the latter function more as honorary organizations and provide

management services for their assigned functions. Although chartered by the Federal Government, no Federal funds are appropriated directly for the operation of the academies. The principal funding source is through negotiated contracts with Federal agencies.

Within the National Research Council there are four permanent entities which deal with ocean-related science and technology: the (1) Marine Board, (2) the Maritime Transportation Research Board, (3) the Ocean Policy Committee, and (4) the Ocean Sciences Board. These organizations and their predecessors have significantly influenced the development of ocean policy since the late 1950s and earlier. Three 1972 studies by the academies, "Oceanography 1960–1970," "Oceanography 1966: Achievements and Opportunities," and "Toward Fulfillment of a National Commitment" were landmarks in evaluating the status of marine science and technology. Much of the work of the NAS/NAE panels, however, is targeted at specific problems or narrow mission areas in response to studies commissioned by executive agencies or, occasionally, congressional committees. The close alliance between NAS/NAE activities and the Federal agencies which are their primary customers has caused congressional caution with regard to accepting the conclusions of Academy studies.

Organization of Federal Ocean Programs

Organization of the Executive Branch to execute the policies developed in the legislative process has provided fertile grounds for debate among students of public administration and political science.

The 5 original departments which were created under the Constitution have since grown to 12 Cabinet-level departments; 58 agencies, commissions, independent regulatory agencies, administrations, authorities, corporations, boards or services; and 3 quasi-Federal agencies. The expansion has come as a result of temporal need: The Department of the Interior was established in 1849 to deal with the disposition of Federal lands in the West; the Department of Agriculture was established in the 19th century at a time when the overwhelming majority of the population was involved in agriculture; the Department of Commerce and Labor was established in the early 20th century as a result of rapid industrial growth, but by 1913 the Department of Labor was made a separate entity in response to the labor movement. More recently, the Department of Housing and Urban Development was established in response to national trends toward urbanization and away from rural areas. Increased use of the family automobile and the consequential decline in the use of conventional mass transit modes led to establishment of the Department of Transportation. The Department of Energy was created in 1977 in response to a major national problem having serious implications for the socioeconomic values of the Nation.

The large number of non-Cabinet agencies is a relatively recent phenomenon that reflects the increased complexity and technical nature of current problems. Beginning in the 1920s and 1930s with the creation of the initial independent regulatory agencies—the Federal Trade Commission (FTC), Securities and Exchange Commission (SEC), and the Federal Power Commission (FPC)—there has been an accelerating trend toward creating more independent agencies with specific missions, such as the Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), and the two energy-oriented agencies, Federal Energy Administration (FEA) and the Energy Research and Development Administration (ERDA) which have recently been incorporated into the new Department of Energy.

Although some programs in separate agencies or departments complement and support one another, these organizational trends tend to diffuse responsibility, introduce redundancy and overlap, and impair lines of communication. Such problems are not unique to government organizations. They are more a function of the size of organizations and may be expected in any large enterprise. Similar deficiencies exist in many large corporations.

Fragmentation of responsibility is blamed for a number of governmental dysfunctions. The Office of Management and Budget (OMB), reporting on the findings of the Ash Council, identified some of the problems: [33]

- It is difficult to solve complex problems when responsibilities for related programs are located in different departments or agencies.
- Problems are defined to fit the jurisdiction of an agency rather than the solutions being sought.
- Results are sometimes gauged on the degree of activity within each program, rather than on the overall impact of all related activities.
- A department's role can be skewed and compromised by the way its mission is described.

[33] U.S. Office of Management and Budget. *Papers Relating to the President's Departmental Reorganization Program: A Reference Compilation.* Washington, D.C., Government Printing Office, 1971, p. 7.

- Narrow missions lead to advocacy for narrow points of view.
- Divided responsibility can overlook some problems; everybody's business becomes nobody's business.
- Interdepartmental competition over jurisdictional matters reduces effectiveness.
- Duplication can result.
- Policies can be at cross-purposes.
- Negotiations to minimize interagency conflicts are time-consuming.
- Originality and boldness are sometimes sacrificed in the quest for intra-governmental harmony.
- Decisions are appealed to the White House, thereby centralizing decision-making, but causing delays and consuming the time of the White House staff.
- A layer of interagency bureaucracy has evolved to fill the need for interagency coordination.
- Fragmentation of responsibility at the Federal level also affects the efficiency of State and local governments.

Present Organization: A Point of Departure

To some extent, the syndrome described by OMB with regard to fragmented responsibility is manifest in the administration of Federal ocean programs which are now dispersed among 9 departments, 8 independent agencies, and 38 agencies or subagencies within Cabinet-level departments. Responsibility is shared by two or more agencies in most major ocean activities and roles assigned to the executive branch (table 9–2). Research is widely dispersed among the ocean agencies by virtue of the diverse nature and indefinite boundaries of research activities that are needed to support development and management, while the development and management roles for ocean activities tend to be more consistently assigned to a single lead agency.

Regulatory activities are a patchwork quilt. Although regulatory decisions are often closely related and frequently affect decisions on the marine and coastal environment or on other resources, the ocean-related regulatory scheme is shared by a number of agencies that make unique decisions on a case-by-case basis. The need for regulatory reform in ocean-related development is as obvious as it is for land-based development. The monitoring and other services provided by numerous ocean agencies generally are conductd in conjunction with responsibilities for regulation or management.

The National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce, was intended by its proponents to provide a central focus for development of civil ocean-related affairs within the Federal Government, yet its budget is less than 10 percent of the total civilian "ocean budget."

NOAA was created pursuant to Reorganization Plan No. 4 of 1970 and Executive Order 11564. Its functions and role, as described in President Nixon's message accompanying the reorganization plan, strongly suggested a lead role for NOAA in the administration of the Nation's civilian ocean affairs. After defining the importance of ocean exploration and development to the United States, the President observed that: [34]

> "Scattered through various Federal departments and agencies, we already have the scientific, technological, and administrative resources to make an effective, unified approach possible. What we need is to bring them together. Establishment of NOAA would do so."

The consolidation of ocean programs into NOAA under Reorganization Plan No. 4, however, fell far short of the proposal for an independent ocean agency made by the Stratton Commission in its final report, Our Nation and The Sea, released in 1969. The plan was a compromise between Congressional supporters of a strong NOAA and a reluctant Administration. The components transferred to NOAA included:

- The Environmental Science Services Administration, already within the Department of Commerce;
- The Bureau of Commercial Fisheries from the Department of the Interior;
- Elements of the Bureau of Sport Fisheries and Wildlife (the migratory marine sport fish program) from the Department of the Interior;
- The Marine Minerals Technology Center of the Bureau of Mines from the Department of the Interior;
- The Office of Sea Grant Programs from the National Science Foundation;
- Elements of the U.S. Lake Survey from the Department of the Army;
- The National Oceanographic Data Center from the Department of the Navy; and

[34] U.S. Congress, House, Committee on Government Operations. Reorganization Plan No. 4. Hearings before a subcommittee of the House Committee on Government Operations. 91st Cong., 2d sess. 1970, p. 6.

Table 9–2.—Division of responsibilities for ocean activities among Federal agencies [1]

DEVELOPMENT

FISHERIES

Commerce
NOAA: hatcheries, economic utilization, fisheries technology, aids to industry, allocation of resources

Interior
Fish and Wildlife Service: hatcheries, habitat enhancement, technical assistance
Bureau of Indian Affairs: Indian fisheries

COASTAL RESOURCES

Commerce
Economic Development Administration
Regional Development Commissions
MARAD: port development
NOAA: coastal energy, impact grants

Interior
Bureau of Outdoor Recreation: land and water conservation programs

OIL, GAS, AND MINERALS

Commerce
Industry and Trade Administration: metals, minerals, and commodity opportunities

Energy
Rate of leasing OCS lands

Interior
USGS: offshore geological surveys
Bureau of Mines: potential of seabed minerals

ENVIRONMENT

EPA
Treatment plant construction grants

SCIENCE AND TECHNOLOGY

Defense
Navy: technology transfer, ship design, subsystems engineering, advanced ships and craft

NSF
Technology transfer

TRANSPORTATION

Commerce
NOAA: marine weather forecasts and reports
NBS: time standards for navigation and regional weather
MARAD: construction and operating subsidies, port development, advanced ship systems, advanced ship machinery, shipping operations information.

NASA
Navigational satellites

Transportation
Coast Guard: maintenance of navigation aids

EDUCATION AND TRAINING

Commerce
NOAA: Sea Grant programs
MARAD: U.S. Maritime Academy, State maritime academies

Defense
Navy: training and education programs, Navy Postgraduate School, U.S. Naval Academy, NROTC

EPA
Treatment plant operators training

HEW
Office of Education

Transportation
Coast Guard: U.S. Coast Guard Academy

[1] **Abbreviations:**

BLM, Bureau of Land Management, **Interior**
CEQ, Council on Environmental Quality
EPA, Environmental Protection Agency
FDA, Food and Drug Administration, **HEW**
FMC, Federal Maritime Commission
FPC, Federal Power Commission
HEW, US Department of Health, Education, and Welfare
ICC, Interstate Commerce Commission
HUD, US Department of Housing and Urban Development
MARAD, Maritime Administration, **Commerce**
NASA, National Aeronautics and Space Administration
NOAA, National Oceanic and Atmospheric Administration, **Commerce**
NSF, National Science Foundation
NIH, National Institutes of Health, **HEW**
OSHA, Occupational Safety and Health Administration, **Labor**
USGS, U.S. Geological Survey, **Interior**

Table 9–2.—Division of responsibilities for ocean activities among Federal agencies (continued)

MANAGEMENT

FISHERIES

Commerce
NOAA: fishery conservation and management, marine mammals

Interior
Fish and Wildlife Service: management in Federal waters

State
Governing international fisheries agreements, Law of the Sea Conference

COASTAL RESOURCES

Commerce
NOAA: Coastal Zone Management Program, estuarine sanctuaries, beach access, barrier islands

Defense
Management of coastal military lands

Interior
National Park Service: national seashore
Fish and Wildlife Service: wildlife refuges

OIL, GAS, AND MINERALS

Interior
BLM: OCS oil and gas leasing

ENVIRONMENT

Commerce
NOAA: marine sanctuaries

EPA
Area-wide waste treatment planning, oil spill contingency plans

SCIENCE AND TECHNOLOGY

Commerce
NOAA: Sea Grant Colleges

Defense-NSF
University National Oceanographic Laboratory System

NSF
Support of laboratory facilities

TRANSPORTATION

Commerce
MARAD: National Maritime Research Centers

EDUCATION AND TRAINING

— —

Table 9–2.—Division of responsibilities for ocean activities among Federal agencies (continued)

REGULATION

FISHERIES

Commerce
NOAA: fishery conservation and management regulations, enforcement and regulation of incidental catching of marine mammals

EPA
Fish and shellfish protection

HEW
FDA: Shellfish Sanitation Program

Justice
Prosecution of violators

Transportation
Coast Guard: Enforcement of fishery conservation and management regulations

COASTAL RESOURCES

Commerce
NOAA: Coastal Zone Management

FPC
Siting energy facilities

NRC
Siting nuclear facilities

HUD
Federal Disaster Assistance Administration: Flood Disaster Program

Transportation
Coast Guard: Port Safety and Security Program

OIL, GAS, AND MINERALS

Commerce
NOAA: aspects of deepwater ports

Defense
Corps of Engineers: permits for offshore structures

Interior
USGS: OCS operations

Labor
OSHA: Safety regulations on offshore operations

Transportation
Office of Pipeline Safety: offshore pipelines
Office of Deepwater Ports: licensing of deepwater ports
Coast Guard: aspects of deepwater ports, safety regulations on offshore structures

ENVIRONMENT

Commerce
NOAA: sign-off on fishery and wildlife coordination actions

Defense
Corps of Engineers: dredge and fill permits

EPA
Ocean dumping permits, National Pollution Discharge Elimination System, air pollution control, review of environmental impact statements

Transportation
Coast Guard: enforcement of oil spill regulations, ocean dumping enforcement, marine sanitation device enforcement

SCIENCE AND TECHNOLOGY

Commerce
NOAA: permits for research in marine sanctuaries

TRANSPORTATION

Commerce
MARAD: shipbuilding requirements

FMC
Regulation of shipping rates

ICC
Regulation of shipping rates in intermodal transportation

NRC
Licensing nuclear power systems

Transportation
Coast Guard: safety inspection and licensing, vessel traffic control

EDUCATION AND TRAINING

Transportation
Coast Guard: licensing operating personnel

Table 9–2.—Division of responsibilities for ocean activities among Federal agencies (continued)

RESEARCH

FISHERIES

Commerce
NOAA: biological and ecological investigations, fisheries technology, aquaculture research

EPA
Pollution impact on fisheries

HEW
FDA: shellfish sanitation

Smithsonian
Oceanography, limnology, and biological research

COASTAL RESOURCES

CEQ
Coastal impact studies

Commerce
NOAA: coastal zone studies, coastal mapping services

Defense
Corps of Engineers: coastal studies, beach erosion studies, navigation in coastal region

EPA
Estuaries and coastal zone research

Interior
USGS: topographical mapping of coastal areas, coastal resources appraisal

NSF
Coastal-zone and land-use studies, regional environmental systems

OIL, GAS, AND MINERALS

Commerce
NOAA: marine mining processing technology

Interior
USGS: OCS resource evacuation, offshore geological surveys

NSF
Seabed resource assessment

ENVIRONMENT

CEQ
Impact assessment on marine environment

Commerce
NOAA: ocean dumping impacts, environmental effects of marine mining, oil in the ecosystem, effects of energy facilities siting
MARAD: pollution prevention ship systems

Energy
Environmental impacts of energy production

EPA
Ocean pollution research, oil spill and hazardous materials research, Great Lakes water quality

Interior
Office of Water Resources Research: protection of fresh water supplies

NSF
fundamental research of source, fate, and impact of pollutants on marine systems

Smithsonian
Chesapeake Bay environmental studies

Transportation
Coast Guard: pollution prevention and cleanup

EDUCATION AND TRAINING

Commerce
NOAA: Sea Grant

NSF
Science Education Program

SCIENCE AND TECHNOLOGY

Commerce
NOAA: oceanographic instrumentation and development, Sea Grant research, ocean circulation, marine ecosystems analysis, remote sensing and marine prediction, manned undersea science and technology

Defense
Navy: oceanographic science, ocean engineering salvage, diving technology, and ship technology
Advanced Research Projects Agency: stable platforms, undersea power systems, underwater detection, advanced submersibles

Energy
Reactor research and power systems

HEW
NIH: basic biological research on human and animal physiology

Interior
Office of Saline Water: desalination research
Bureau of Reclamation: subsea conveyance of fresh water

NASA
Satellite applications research

NSF
International Decade of Ocean Exploration, ocean sediment coring program, Arctic and Antarctic research

TRANSPORTATION

Commerce
MARAD: shipbuilding technology, ship systems, nuclear vessels, shipboard automation

Transportation
Coast Guard: search and rescue techniques, vessel pollution abatement systems

Table 9–2.—Division of responsibilities for ocean activities among Federal agencies (continued)

MONITORING AND SERVICES

FISHERIES

Commerce
NOAA: fishery resource monitoring assessment and prediction, industry statistics, economic and marketing information

Interior
Fish and Wildlife Service: monitoring fish populations
Bureau of Indian Affairs: fishery statistics and information related to Indian fishing rights

COASTAL RESOURCES

Commerce
NOAA: coastal mapping, data on use of coastal region, coastal and ocean satellite imagery

Defense
Corps of Engineers: beach erosion, information, coastal use information, water levels in Great Lakes

Interior
USGS: coastal region resource information and monitoring, topographic mapping

NASA
Monitoring land resources

OIL, GAS, AND MINERALS

Energy
Monitoring OCS oil and gas development

Interior
BLM: compile statistics on OCS oil and gas operations
USGS: compile information on offshore minerals

ENVIRONMENT

Commerce
NOAA: Great Lakes data, ocean dumpsite survey and monitoring, environmental satellite service, environmental data and information services

Interior
Fish and Wildlife Service: monitor construction activities on navigable waters

EPA
Great Lakes water quality, assessment of pollutants in estuaries and coastal waters

NASA
Remote sensing of oceanographic features

Smithsonian
Oceanographic and marine sorting centers

SCIENCE AND TECHNOLOGY

Commerce
NOAA: ocean mapping investigations, data buoy system, for data sensing, atmospheric and oceanographic information, ocean circulation, structure and motion of ocean, environmental satellite service, oceanographic data center

Defense
Navy: bathymetric and geophysical measurements, tactical systems survey, hydrographic surveys

TRANSPORTATION

Commerce
NOAA: nautical chart service, marine weather forecasts and reports

Defense
Defense Mapping Agency: nautical charts and sailing directions

Transportation
Coast Guard: operation of LORAN, radio beacons and navigation aids, publications, oil spill surveillance and monitoring, search and rescue, port safety/security surveillance

EDUCATION AND TRAINING

Commerce
NOAA: Sea Grant marine advisory service

- The National Data Buoy Project from the Department of Transportation.

In defining the role to be played by NOAA in oceanic affairs, the President's memorandum circumscribed the agency's functions primarily to research and development: [35]

"I expect that NOAA would exercise leadership in developing a national oceanic and atmospheric program of research and development. It would coordinate its own scientific and technical resources with the technical and operational capabilities of other Government agencies and private institutions."

[35] *Ibid*, p. 8.

Additional responsibilities were assigned to NOAA by the Coastal Zone Management Act of 1972 (and expanded under the 1976 amendments), Deepwater Ports Act of 1972, ocean dumping responsibility under the Marine Research and Sanctuaries Act of 1972, Marine Mammals Protection Act, of 1972, and the Marine Fishery Conservation and Management Act of 1976. All of the recently assigned administrative responsibility, with the exception of ocean dumping, is regulatory or developmental rather than research in nature. Thus, the character of NOAA's mission is slowly changing, as are the demands on its administrative framework.

Those arguing for reorganization of the ocean-related functions in the agencies cite lack of coordination among the ocean programs as evidence of the consequences of dispersed and fragmented responsibilities under the present organizational scheme. The relative lack of communication between the research support activities in NOAA, NSF, EPA, and the Department of the Interior is one example cited in support of this argument. The absence of close coordination, they conclude, results in an incapacity to bring about cohesive national policies, reduces administrative efficiency, and promotes lack of accountability. Advocates of this view believe that divided responsibility for ocean activities prevents a clear decision on what the Nation's priorities should be, and how they should be accomplished in the needed time frame.

Few argue that the Nation's ocean programs are well coordinated; however, in rebuttal to the proposals for broadscale reorganization of the ocean effort, the opponents see a need only for limited consolidation of programs and an interagency coordinating mechanism to facilitate the formulation of high-level policy and ensure collaboration among the responsible agencies.[36]

Organizational effectiveness cannot be gauged objectively; thus conclusions tend to be based on casual observations or subjective opinions. The need for reorganization is frequently placed on the logic of inherent faith that things can be done better. Whether integration and consolidation of the ocean programs into larger unit operations can achieve better administration is similarly accepted or rejected as an article of faith.

The fundamental question is whether the way we have divided the responsibility for ocean-related programs among the departments is the best way to conduct the Government's business. The answer depends on the standards used in judging, the nature of the evidence considered, and agreement on the overall policy objectives.

Split Jurisdiction: A Special Organizational Problem

One group of ocean programs presents unique organizational problems that stand above the general concern for overall program coordination. These are the programs that split the responsibility for implementation among two or more agencies in different departments. Several ocean programs are of this character.

Responsibility for the protection of marine mammals is shared by the Department of Commerce, Department of the Interior, and the Marine Mammal Commission.

The Endangered Species Act of 1973 assigns the responsibility for enforcement to the Department of the Interior and the Department of Commerce.

Regulation of ocean dumping is jointly administered by NOAA, EPA, and the Corps of Engineers.

Although the management of marine fisheries is the responsibility of NOAA within the Department of Commerce (through regional fisheries councils), responsibility for management of anadromous species, which inhabit both fresh- and saltwater during portions of their life cycle, is divided between NOAA, the Fish and Wildlife Service of the Department of the Interior, and the Department of State.

Placement of structures in navigable waters offshore with pipelines ashore can involve the Department of Energy, Interstate Commerce Commission, Department of Transportation, Corps of Engineers and EPA.

Notwithstanding a self-proclaimed spirit of cooperation among the responsible agencies, many observers have related "horror tales" of interagency squabbling and "bureaucratic paralysis" in certain shared programs.[37] If the assigned responsibilities are complementary, i.e., the tasks to be performed are uniquely matched to the respective capabilities of the agencies, shared responsibility can be implemented effectively. Thus, the administration of the Deepwater Port Act of 1974 has progressed satisfactorily under the authority of the Coast Guard (and the Department of Transportation) with the requirement for consultation with NOAA.

However, where the division of responsibility is based on an artificial separation, such as species or habitats bearing little relationship to the problems as found in nature, implementation is often impeded or confused and the chances of omissions and over-

[36] U.S. Congress, House, Committee on Merchant Marine and Fisheries. An Overview of National Ocean Policy Problems, Issues, and Administration, Based on Hearings before the Oceanography Subcommittee. Ser. 94–L, 94th Cong., 2d sess., 1976—a general discussion of the need for ocean reorganization.

[37] U.S. Congress, Senate, Committee on Commerce. *Ocean Dumping Regulation: An Appraisal of Implementation.* 95th Cong., 2d sess., 1976.

sights are increased. This has resulted in a curious partitioning of authority under the Marine Mammal Protection Act. For example, NOAA in the Department of Commerce is responsible for such mammals as whales and seals; whereas the Fish and Wildlife Service in the Department of the Interior is responsible for sea otters and walruses.

Further complications arose in the case of the threatened green sea turtle, which, under the Endangered Species Act, required a Memorandum of Understanding between the Department of Commerce and the Department of the Interior giving NOAA responsibility for the turtles if they are swimming and the Fish and Wildlife authority if they are on land. Anadromous fish similarly come under two management regimes, administered by NOAA and the Fish and Wildlife Service on the basis of whether the fish are in fresh- or saltwater and whether they are indigenous to Pacific waters, the Great Lakes, or the Atlantic. The jointly administered programs clearly need special attention, whether considered in the context of overall ocean reorganization or as an incremental measure to consolidate the most troublesome coordination programs.

Organizational Options and Principles

No magic formulas exist for organizing Government functions. Theories abound, but the problems of organization are not wholly structural. The organizational options are limited by a number of practical considerations and external factors that influence or constrain the final outcome:

- Statutes and congressional enactments establish the top and bottom line of authority—executive agencies can neither expand nor contract the requirements of the statutes.
- Agencies are collective fiefdoms, generally presided over by competitive and aggressive administrators—tidy organizational charts frequently fail to depict accurately the power structure and decision path.
- Constituents of a Federal program often make more difference in the operation of an agency than does the organizational locus within the Government.
- Agency jurisdiction should be matched to congressional committees' jurisdiction to the extent possible in order to avoid future program fragmentation.

Any reorganization of the Federal ocean effort, while simple in concept, would be complex in practice. Federal agencies do not exist in isolation; they are highly interdependent. To take programs from one department can significantly affect the donor agency to the extent that its organizational integrity and operational efficiency are impaired. A critical mass must be maintained in the organizations from which programs are transferred. Also there is a need to ensure that the recipient agency has the necessary programs to make it an effective administrative unit.

Organizational problems are often less "structural" than they are "people problems." The human dimension must be considered in any organizational scheme. It is well proven that good faith, competence, professionalism, and dedication can overcome many organizational deficiencies. Proper organization can minimize the administrative barriers that tend to impede communication and reduce administrative effectiveness. However, this is a passive quality of organizational structure. Leadership and initiative provide the active quality. To the end that organization can provide the proper mix of talent and resources at an appropriate level of visibility in order to attract those with leadership ability, organization can contribute to the active and responsive qualities of good government in an indirect way.

Agencies with closely related and interacting responsibilities often compete for new authority and vie for common aspects of existing programs. Dynamic tension among the competing agencies can serve to improve general performance in Government. However, good administration can suffer when interagency competition becomes merely self-serving or where duplication and confusion result. The line between the extremes is narrow and ill-defined. Competition is inherent in any organization and within its subunits. The factor of interagency and interunit competition not only should be acknowledged in an organization scheme, but should be skillfully used by administrators to improve the performance of the organization as a whole.

Organizational Structure and Status

Whether the Federal ocean program should be reorganized is a question that must be determined on the basis of its relative benefits and costs. A decision that Federal ocean activities are of sufficient importance to warrant a consolidation of the present separate agencies is obviously a critical policy judgment.

If reorganization is to be undertaken, four questions are to be answered. (1) Should the entity be independent or part of an existing department? (2) If independent, should the organization be an agency, administration, or a Cabinet-level department? (3) Should the organization be based upon functional lines, resource objectives, disciplines, or regional

services? (4) How should responsibility for development, regulation, and research be allocated to the new entity?

Independent Agency or Cabinet-Level Department?

The Stratton Commission strongly recommended the creation of an independent agency to manage the Nation's ocean affairs. The National Advisory Committee on Oceans and Atmosphere (NACOA), which recommended an ocean agency 5 years later, was less definite in its recommendations, concluding that, "the form is less crucial than the need to take action now."[38] The Ash Council concentrated on building the natural resource functions (including the oceans) into an expanded Department of the Interior.[39]

The debate on the form that a new ocean organization should take often turns on how much influence or "clout" an independent agency could muster as compared to a Cabinet-level department. Often the influence depends less on the rank of the administrator than on his personal influence in the Administration. However, it is generally believed that Cabinet-level officers have greater access to and are more influential with the President and other Cabinet officers than are administrators of independent agencies or sub-Cabinet-level administrations. According to some persons, the proliferation of independent agencies also has tended to weaken the impact that such agencies have on high-level policy, or has compounded the problem of interagency coordination. Generalities frequently break down, however, and notable successes, such as the National Aeronautics and Space Administration, and the Environmental Protection Agency are cited to rebut the presumption of Cabinet-level superiority.

The question of a Cabinet-level or sub-Cabinet-level agency borders on the esoteric because there is no explicit authority in the United States Constitution or in the statutes for a "Cabinet." It is a creation of the Presidency. Anyone whom the President may select—be it an administrator of an independent agency or a White House aide—can be a member of the Cabinet by designation. What is implied by the advocates of Cabinet-level rank for an ocean administrator is the need for access to the President, influence in the White House, and the stature and visibility to ensure that ocean programs are given priority in the consideration of pending issues and in the budget process that they feel ocean matters merit.

It is a matter of conjecture whether the Office of Management and Budget (OMB) and other centers of power exercise more control over the self-determination of an independent agency than over the internal workings of a Cabinet-level department. Public accountability has always played an important part in the U.S. governmental system at all levels of administration from the President down. Administrators of independent agencies, as well as Cabinet officers, are equally accountable to the press and the public, and are subject to congressional oversight.

Integration by Function or Resource?

Whether Government organizations should be predicated on functional lines, e.g., energy, food, transportation, and labor, or whether they should be organized on the basis of resources, e.g., land, water, people, and oceans is a fundamental question. To some extent this is merely another way to ask the question: Is the ocean a sensible theme for integrating the functions of Government?

Gulick recognized four basic organizational themes around which governmental activities can be classified: Purpose (*function*), Process (*discipline*), Persons/Resources (*clientele/materials*), and Place (*regional*).[40] The present governmental structure of ocean-related activities is a mixture of each of these organizational themes (table 9–3). To some extent, the classification of Government programs within this framework is arbitrary and the separations between functions and resources is contrived and artificial. Societal problems and organizational solutions do not segregate as neatly as organizational theorists would presume. In the balance, however, it appears that present governmental organization favors the "functional" or "purpose" approach, although organization around "resources" or "clientele" is predominant in a number of ocean activities.

Organization by Function

Organization by purpose or function brings together the programs, capabilities and services needed to achieve the objectives of identified societal goals. Functional organization, therefore, is structured around classes of governmental activities such as food, energy, health, housing, environment, science and technology, defense, and transportation. The functional classification of the ocean and coastal activities is shown in figure 9–3. The Council on Executive Reorganization (The Ash Council) in 1971 recommended that the Executive Branch be organized around the "goals" of natural resources, communities, human resources, and economic affairs. This represented organization by function at a higher level of generality.[41]

The advantages of functional organization are: (1)

[38] National Advisory Committee on Oceans and Atmosphere. Third Annual Report to the President and the Congress. Washington, D.C., Government Printing Office, 1974, p. 15.

[39] U.S. Office of Management and Budget, op. cit. note 33.

[40] Luther Gulick. "Notes on the Theory of Organization," *Papers on the Science of Administration*, Luther Gulick and L. Urwick (eds.) New York: 1937, p. 15.

[41] U.S. Office of Management and Budget, op. cit. note 33.

Table 9–3.—Classification of Federal agencies by organizational approach to ocean activities

Purpose (Function)	Process (Discipline)	Persons/Resources (Clientele/Materials)	Place (Regional)
Department of Agriculture Agricultural Research Service	**Department of Justice**	**Department of Agriculture** Soil Conservation Service	**Department of Commerce** Economic Development Administration Regional Development Commission NOAA Office of Coastal Zone Management
Department of Commerce National Bureau of Standards NOAA: National Ocean Survey Environmental Research Labs. National Weather Service	**Department of State**	**Department of Commerce** NOAA: National Marine Fisheries Service Sea Grant Maritime Administration	**Department of the Interior** Office of Territorial Affairs
Department of Defense Navy Defense Mapping Agency Defense Advance Research Projects Agency Corps of Engineers Military Sealift Command Military Traffic Management Command U.S. Army Transportation Center		**Department of Energy** **Federal Maritime Commission** **Federal Power Commission** **Department of the Interior** Fish and Wildlife Service National Park Service Bureau of Indian Affairs Bureau of Land Management **Interstate Commerce Commission** **Marine Mammal Commission** **Department of Transportation** Office of Pipeline Safety Office of Deepwater Ports	
Environmental Protection Agency			
Department of Health, Education, and Welfare National Institutes of Health Federal Drug Administration			
Department of the Interior Bureau of Reclamation Office of Water Resources Research Office of Saline Water Bureau of Outdoor Recreation U.S. Geological Survey			
National Aeronautics and Space Administration			
Department of Labor Occupational Safety and Health Administration			
National Science Foundation			
Department of Transportation U.S. Coast Guard			
Smithsonian Institution			

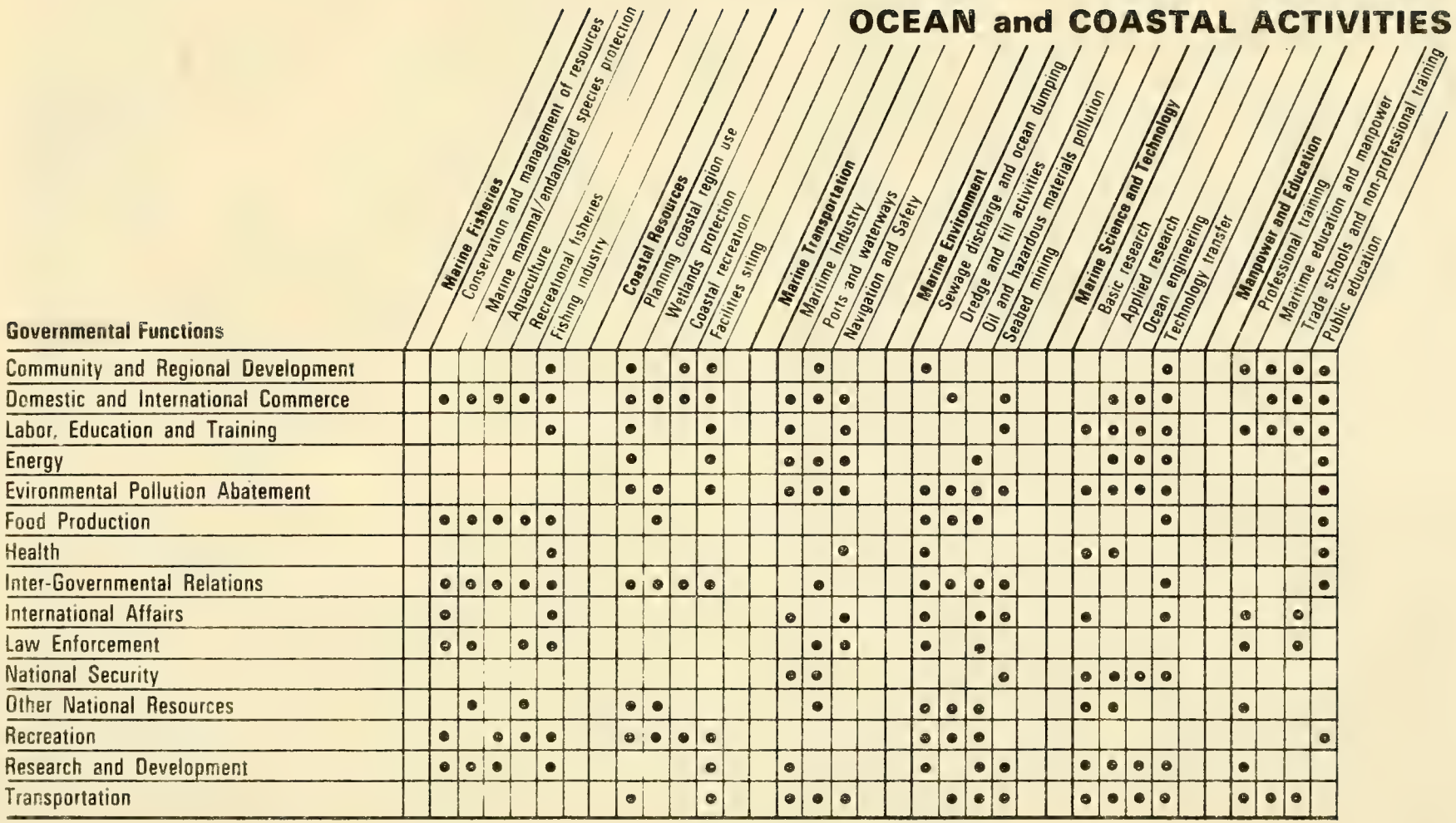


Figure 9–3.—Ocean and coastal activities by functional classification.

Administration is direct and the necessary interdisciplinary skills and capabilities to achieve governmental objectives are under the span of control of a single responsible official; (2) Functions are easily identifiable to the public, and the goals of Government are visible and obvious; and (3) Energies and loyalties of the employees are focused on a given objective.

The disadvantages and problems associated with functional organization are: (1) It is impossible to cleanly divide all the programs and work of Government into a few major functional categories with discrete responsibilities; (2) There is danger that subordinate and related activities will be inadvertently suppressed or lost sight of because of the singleness of purpose; (3) Unity of control and direction over a functional area can lead to centralization of authority, monolithic attitudes, and constrained debate, thus reducing the benefits derived from constructive disagreement; and (4) A functional organization that is staffed and equipped from top to bottom to perform the necessary activities without outside assistance can easily drift into an attitude of complete independence and indifference to external considerations.

Organization by Resource

Organization by resource is predicated on assembling governmental capabilities into a single unit that can accomplish the multiple objectives of a single target resource or target groups. Thus, Resource/Person organization is based upon orienting administration around classes of natural resources or identifiable public groups, e.g., veterans, labor, farmers, business (commerce), banks, forests, fisheries, marine mammals, ocean shippers, and truckers. Under a "resource" organizational scheme, some if not all of the functional activities are included under a comprehensive management system that embraces all of the program objectives that use, impact, or directly affect the resource base.

Advantages of organizing by resource include: (1) Use and protection of a resource is simplified when all functional activities relating to the specific resource are in one organization; (2) Proficiency is gained through knowledge of the resource base as a result of in-depth involvement with the resource; and (3) Coordination of resource use and protection activities is easier when functional activities are focused through a resource-oriented organization.

Disadvantages of organizing by resource include: (1) The same organization must perform a number of specialized functions; therefore, a resource organization with multiple missions may not be capable of matching the proficiencies of an organization based on a single function; (2) Achievement of functional goals may be made more difficult by emphasizing one resource's values over other resource activities through an organizational focus on a single resource; (3) Constitutent groups with a stake in a particular resource may be able to unduly influence an organization which is responsible only for a single resource base; and (4) Parochialism can develop over time if an organization deals solely with one resource and is remote from the consideration of other natural resources.

Singling out the ocean as an integrating theme for a resource-oriented organization tacitly implies that there are characteristics and factors which distinguish ocean resources from land and other resources. There have been no comparable proposals that there be a "land" agency as such, and clearly such a suggestion would be considered nonsense. Elliot Richardson identified four unique factors that differentiate ocean-based efforts from land-based efforts:[42]

- Ocean resources are common property resources and are therefore wholly in the public domain. Decisions on allocation of ocean resources and resolution of conflicting usage are public policy decisions for governmental institutions to deal with in the public interest.
- Ocean activities interact and impact one another in a more direct way than comparable land-based activities. Remote uses may have a pervasive influence on a corresponding use some distance away; thus a different kind of interdisciplinary and interjurisdictional management effort is needed.
- Technology needed for development of marine resources is significantly different from that associated with similar land-based resource development.
- The ocean constitutes an area in which U.S. interests butt up against the interests of other countries. Therefore, there is an important international ingredient involved in resolving ocean problems.

Whether the ocean, as a resource, is a sensible integrating theme for organizing the Federal ocean effort must be determined on the basis of these distinguishing characteristics weighed against the organizational options of "function" versus "resource" and modified by other reorganizational efforts in the Federal Government that may affect any possible reorganization of Federal ocean activities.

Separation of Development and Regulatory Activities

Governmental functions can be classified generically as: (1) development (promotion), (2) regulation, (3) research, and (4) monitoring/services. How

[42] U.S. Congress, House, Committee on Merchant Marine and Fisheries. National Ocean Policy, Hearings before Subcommittee on Oceanography. 94th Cong., 2d sess., Ser. 94–43, 1976, pp. 8–9.

these functions are separated or combined in a new organizational scheme significantly affects agency behavior. Since the Atomic Energy Commission (AEC) was divided into the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC) by the 93d Congress, most reorganizational proposals have suggested that responsibilities for promoting or developing a resource should be separated from the responsibilities for regulating the industry involved. This premise, however, is neither a categorical imperative nor an article of faith.

The recently created Department of Energy (DOE) has blended the responsibility for development and regulation of energy production and delivery into the organization by building safeguards in the regulatory system in order to maintain an arms-length relationship between promotional activities and regulatory practices. The current acceptance of the coexistence of these two functions in the same department is based on a distinction between the two types of regulatory activities: (1) that which is to control the economics, production, and competition within the industry, and (2) that which is to protect other values, e.g., environment, health and safety.[43] The former, it is suggested, can safely be integrated with promotion, while the latter should remain separate. Therefore, it is the quality of the regulatory activity that determines the compatibility rather than the mere regulatory label.

Recommendations for Reorganization

A number of recommendations for executive reorganization have been made by study panels, commissions, advisory committees, academicians, and legislators in recent years. Those of the Stratton Commission and NACOA concentrated on Federal ocean programs. The Ash Council, with a mandate to look broadly at programs related to natural resources, proffered recommendations that would encompass all natural resource, ocean, atmosphere, and earth sciences. Professor John Norton Moore addressed not only the problems of organizing Federal ocean programs within the Federal agencies, but also suggested changes in the organization of the Department of State's Bureau of Oceans and International Environmental and Scientific Affairs, and creation of a Cabinet-level Marine Affairs Council in the White House. Senator Ernest F. Hollings, on the other hand, introduced S. 3889 in the Second Session of the 94th Congress in which he proposed the creation of a Department of Environment and Oceans (DOE). These efforts represent the conventional wisdom on reorganizing the Government to execute the Nation's ocean policy (fig. 9–4).

Stratton Commission Recommendations (1969)

The Stratton Commission's report. *Our Nation and the Sea,*[44] concluded that:

> ". . . the national ocean program recommended by this Commission can be achieved only by creating a strong civil agency within the Federal Government with adequate authority and adequate resources. No such agency provides an adequate base on which to build such an organization."

It proposed the creation of an independent ocean agency, the National Oceanic and Atmospheric Agency (NOAA), which would include:

- United States Coast Guard.
- All of the entities included in NOAA except the National Oceanographic Instrumentation Center, National Data Buoy Development, and the Marine Minerals Technology Center.
- Marine and anadromous fisheries functions of the Bureau of Sports Fisheries and Wildlife within the Department of the Interior.

Because many of the new Federal ocean programs enacted since 1969 were rooted in recommendations by the Stratton Commission—coastal zone management, ocean dumping, fisheries management—it was implied by the Commission that such programs when implemented would be centered in the independent ocean agency.

The rationale upon which the Commission based its organizational recommendation can be summarized as follows:

- A major and diverse effort is required in the oceans, and the size and scope of such an effort cannot be fitted into an existing mission agency.
- An independent agency would bring a fresh outlook and institutional freedom which are difficult to achieve in an old line agency.
- It would be visible and draw greater public interest and support by developing a constituency.

[43] U.S. Congress, House. The Organization of Federal Energy Functions. H. Doc. 95–43, 95th Cong., 1st sess., 1977.

[44] Report of the Commission on Marine Science, Engineering, and Resources, op. cit. note 30, p. 229.

DEPARTMENTS AND AGENCIES	NATIONAL OCEANIC AND ATMOSPHERIC AGENCY (1969) STRATTON	DEPARTMENT OF NATURAL RESOURCES ASH COUNCIL (1971)	NACOA (1974)	DEPARTMENT OF ENVIRONMENT AND OCEANS MOORE (1976)	HOLLINGS (1976)
DEPARTMENT OF COMMERCE					
Maritime Administration				x	
National Oceanic and Atmospheric Administration		x	x	x	x
Environmental Data Service		x	x	x	x
National Oceanographic Data Center [1]	x	x	x	x	x
Marine Minerals Technology Center [2]		x	x	x	x
National Environmental Satellite Service		x	x	x	x
National Marine Fisheries Service [3]		x	x	x	x
National Ocean Survey		x	x	x	x
U.S. Lake Survey [4]		x			
National Sea Grant Program [6]	x	x	x	x	x
National Weather Service [6]	x	x	x	x	x
Office of Coastal Zone Management			x	x	x
Office of Ocean Engineering					x
National Data Buoy Project [7]		x	x	x	x
National Oceanographic Instrumentation Center		x	x	x	x
DEPARTMENT OF INTERIOR					
Bureau of Commercial Fisheries [8]	x				
Bureau of Land Management					
Ocean-Related Activities but Not OCS Leasing		x			
OCS-Related Activities Including OCS Leasing			x	x	
OCS Environmental Baseline Studies					x
Bureau of Reclamation (Ocean and Atmospheric Programs)				x	
Fish and Wildlife Service [9]		x			x
Anadromous Species and Marine Mammals	x			x	
National Park Service					x
Ocean Mining Administration				x	
U.S. Geological Survey		x	x	x	
(Mapping, OCS Regulation and Selected Research Functions)					x
DEPARTMENT OF DEFENSE					
Corps of Engineers					
Civil Marine and Coastal Programs			x	x	
Dredge and Fill and Ocean Dumping Function					x
Selected Civil Activities Related to Regulation and Studies		x			
U.S. Lake Survey [10]	x				
DEPARTMENT OF TRANSPORTATION					
U.S. Coast Guard	x		x	x	x
ENVIRONMENTAL PROTECTION AGENCY					
All Functions					x
Ocean Research and Monitoring				x	
NATIONAL SCIENCE FOUNDATION					
Ocean Research and IDOE			x	x	x
National Sea Grant Program [11]	x				

[1] Formerly Navy (DOD)
[2] Formerly DOI
[3] Formerly Bureau of Commercial Fisheries (DOI)
[4] Formerly Corps of Engineers (DOD)
[5] Formerly NSF
[6] Formerly Environmental Science Services Administration
[7] Formerly National Buoy Development Project (DOC)
[8] Transferred to National Marine Fisheries Service (DOC)
[9] Formerly Bureau of Sports Fisheries and Wildlife (DOI)
[10] Transferred to National Oceanographic and Atmospheric Administration (See DOC)
[11] Transferred to National Oceanographic and Atmospheric Administration (See DOC)

Figure 9–4.—Major reorganization proposals to execute the Nation's ocean policy, 1964–76. An "X" indicates inclusion of the agency in a new organization.

- The Administrator of the agency would be better able to organize and devote attention to ocean activities than a Secretary of a large department which has other missions.
- Direct access to the President for coordination of Government-wide ocean actitivities would be facilitated.

The Stratton Commission's report in 1969 was instrumental in motivating the Administration to create NOAA within the Department of Commerce in 1970. Although the Commission saw an independent NOAA as one with regulatory, enforcement, developmental, management, and research authority, NOAA as now constituted is predominantly research and development-oriented, within the exceptions noted above.

President's Advisory Council on Executive Reorganization—The Ash Council (1971)

The Ash Council—the President's Advisory Council on Executive Reorganization—was created by President Nixon in 1969 as a one-shot advisory group within the Executive Office of the President. Its report was submitted in May 1970 and released in February 1971, followed closely by a reorganization message to Congress outlining the proposal for a Department of Natural Resources.[45] Among the five major components identified for consolidation was "marine resources and technology." The internal structure of the department would have included an Oceanic, Atmospheric, and Earth Sciences Administration which would have been formed by merging NOAA and the U.S. Geological Survey. The modest proposal, as far as ocean programs were concerned, fell far short of the Stratton Commission recommendations. The rationale for the Ash Council proposal was based on the similarity of functions between NOAA and USGS in scientific data acquisition and mutuality in earthquake, hydrologic and cartographic activities. Hearings were held in the 92d and 93d Congress on the Department of Natural Resources (DNR) and Department of Energy and Natural Resources (DENR) approaches, but no further legislative action was taken. The proposals did not resurface in the 94th Congress.

National Advisory Committee on Oceans and Atmosphere: Third Annual Report (1974)

The National Advisory Committee on Oceans and Atmosphere (NACOA) concentrated on ocean organizational problems in its Third Annual Report, issued in 1974. Not unlike the Stratton Commission, it recommended a broadly based ocean agency, but left the question open as to whether it could best function as an independent agency, within an existing department, or in a new multi-purpose department, such as the Department of Energy and Natural Resources (DENR) which was under consideration at that time. In effect, the proposal was for an expanded NOAA which would be augmented by the additional functions of:

- U.S. Geological Survey (USGS);
- Corps of Engineers' marine and coastal programs;
- Bureau of Land Management (BLM) OCS mineral leasing program;
- Marine fisheries program of the Bureau of Sport Fisheries and Wildlife; and
- U.S. Coast Guard (USCG).

NOAA's responsibilities were to include:

- Assessment and management of fisheries and marine mammals;
- Assisting the commercial fishing industry;
- Stimulating and supporting sport fishing and recreation;
- Assessment and management of nonliving marine resources;
- Assisting energy and mineral industries operating in the marine environment;
- Coordinating marine, atmospheric, and coastal zone affairs;
- Regulating and enforcing ocean activities;
- Advising and counseling other Federal agencies and States on ocean affairs;
- Planning for comprehensive use of the marine resources and environment; and
- Coordinating weather modification activities.

NACOA's recommendations for reorganization were in response to the Ash Commission's recommendations for consolidating all natural resource functions into a DNR or DENR. Oceans were to be included under the broad rubric of natural resources. NACOA saw four major deficiencies in the DENR proposal:[46]

> "First, they lack a suitable marine affairs policy statement which would draw attention to the uniqueness of the problems of marine resources management . . . Second,

[45] U.S. Office of Management and Budget, op. cit. note 33, pp. 153–223.

[46] *National Advisory Committee On Oceans and Atmosphere*, op. cit. note 38, p. 15.

the bills are inadequate with regard to the functions we feel must be carried out by DENR to implement marine affairs policy . . . Third, their deficiency is the failure to specify which functions will and which functions will not be the responsibility of a marine affairs administrator . . . Fourth, the function of marine multiple-use coordination and regulation was not recognized at all."

The Moore Proposal (1976)

Professor John Norton Moore, Director, Center for Oceans Law and Policy at the University of Virginia, recently advanced a three-pronged reorganization proposal which would (1) create a Cabinet-level Marine Affairs Council, (2) centralize nonmilitary ocean programs under a strengthened and independent NOAA, and (3) strengthen and recognize the existing State Department Bureau of Oceans and Environment.[47]

Under the Moore proposal, the following functions would be transferred to the new ocean administration:

- The Coast Guard;
- The Maritime Administration (MARAD);
- The Outer Continental Shelf programs of the Bureau of Land Management and the Geological Survey;
- The Ocean Mining Administration of the Department of the Interior;
- Marine and coastal zone activities of the Army Corps of Engineers;
- Most ocean research programs of the National Science Foundation (including the International Decade of Ocean Exploration);
- Most ocean research and monitoring programs of the Environmental Protection Agency;
- Ocean and atmosphere activities of the Bureau of Reclamation; and
- Some ocean-related activities of the Fish and Wildlife Service, particularly programs for andromous species and marine mammals.

The proposal is significantly different from its predecessors. By including the Maritime Administration (MarAd), which is now in the Department of Commerce, in an up-graded independent NOAA, the Moore proposal recognizes the importance of maritime transportation to our national ocean posture. The proposal also would transfer the ocean pollution functions of EPA to the expanded agency and bring the entire program of ocean pollution control into a single entity, thereby avoiding the pitfalls of split jurisdiction.

Reorganization of the Bureau of Oceans, Environment, and Science within the Department of State is aimed at giving the oceans more prominence and attention in international affairs. The Bureau was created at the initiative of Congress, and, in the process of implementation at the department level, was merged with other disparate programs including science and environment. This, according to some observers, has diminished the effectiveness of the Bureau in dealing with international ocean affairs, particularly the Law of the Sea negotiations.

The Hollings Proposal: Department of Environment and Oceans (1976)

The Department of the Environment and Oceans Act, S. 3889, was introduced September 30, 1976, too late in the 94th Congress for further action, but its introduction served as a means for developing discussion and debate for the 95th Congress. It is the first congressional attempt to create an independent ocean agency since the flurry of proposals that emanated immediately after the release of the Stratton Commission report in the 91st Congress.[48]

In the statement of introduction for S. 3889, the bill's sponsor, Senator Ernest F. Hollings, chairman of the Senate National Ocean Policy Study, cited five major goals of the proposal: [49]

- Minimize the unnecessary duplication and overlap which now exists;
- Provide the type of organizational setting where coherent national policies for managing and protecting the environment, the oceans, and their resources can and will be carried out, and where a new sense of direction can develop in the executive branch;
- Increase the accountability by fixing responsibility squarely, and remedying the present situation where no one is in charge and thus no one is held accountable;
- Unify the now myriad permit processes which confuse the Federal Government and burden industry and State and local governments with enormouse amounts of unnecessary redtape; and
- Bring ocean and environmental affairs into the Cabinet, where they can get the high-level attention they deserve in this era of increasing demands on these resources.

[47] John Norton Moore, op. cit. note 21.

[48] See, generally, H.R. 3848, 4838, 15147, 15233, et al., S. 2054 and 2204, 91st Cong., 1st sess. (1969); approximately 15 reorganization bills for creating an independent ocean agency were introduced in the 91st Congress.

[49] U.S. Congress, Senate. Senator Ernest F. Hollings in statement of introduction for S. 3889. 94th Cong., 2d sess., 1 October 1976, *Congressional Record* 122: S 17854.

Senator Holling's proposal would establish a Department of Environment and Oceans (DEO) which would combine the activities of the Environmental Protection Agency (EPA), an independent regulatory agency in function, with the National Oceanic and Atmospheric Administration (NOAA), an administration within the Department of Commerce, the U.S. Coast Guard, a component of the Department of Transportation, and certain programs under the jurisdiction of the Corps of Engineers. The rationale for coalescing environment and ocean affairs into a single Cabinet-level department is grounded on three organizing principles according to its sponsor: (1) Responsibility for managing the Nation's common property resources—those that belong to no single person or group of persons; (2) separation of responsibility for Government functions, to avoid conflicts caused by pursuing differing goals for regulation, enforcement, research, and economic development, and (3) dynamic organization that would develop the internal structure of DEO after its creation.[50]

Organizationally, DEO would comprise six functional administrations and the U.S. Coast Guard, each directed by an Assistant Secretary: Clean Air Administration, Water Quality Administration, National Oceans Administration, Recreation and Parks Administration, Environmental Hazards Control Administration, and the National Atmospheric Service Administration. Rather than transfer functions identified with an organizational entity, as has been the practice with executive reorganization plans, S. 3889 transfers the programs by reference to the authorizing legislation and makes conforming amendments to the environmental and ocean-related statutes to reflect the transfer of authority and revest the powers of the Secretary of the Environment and Oceans.

Components of DEO would include the following organizational entities and/or programs:

(1) Bureau of Land Management (Department of the Interior) functions relating to environmental baseline studies with respect to the Outer Continental Shelf;
(2) Bureau of Reclamation (Department of the Interior) functions relating to modification of the weather;
(3) Bureau of Outdoor Recreation (Department of the Interior);
(4) U.S. Coast Guard (Department of Transportation);
(5) Corps of Engineers (Department of the Army) research and regulatory functions relating to marine and coastal affairs, including activities for regulation of ocean dumping, protection of wetlands, permitting of offshore structures, and research on and control of erosion and other coastal processes;
(6) Environmental Protection Agency;
(7) Fish and Wildlife Service (Department of the Interior);
(8) Geological Survey (Department of the Interior) functions relating to topographic surveys and mapping; regulation of exploration, development and production activities on the Outer Continental Shelf; research in support of regulation; land information and analysis; and research on earthquake hazard reduction;
(9) National Oceanic and Atmospheric Administration (Department of Commerce; and
(10) The National Park Service (Department of the Interior).

The DEO concept goes beyond any recommendations made previously by advisory groups in the community of ocean professionals. However, by coupling environment and oceans in a Cabinet-level department, the vulnerability of a relatively small independent ocean agency with limited clout would be traded for department-level status that would put ocean and environment on a par with energy and other resource considerations.

Multipurpose Reorganizational Proposals (94th Congress): Department of Natural Resources—Energy—Environment

Reorganization bills that would consolidate natural resources, energy, and environmental groups have been introduced in every Congress since 1971. The early bills of the 92d and 93d Congress, which proposed the creation of a Department of Natural Resources or a Department of Energy and Natural Resources would have transferred NOAA and other ocean-related programs to what, in effect, would be an expanded Department of the Interior. Recent bills with their genesis in the old DNR/DENR concepts, such as S. 3339, and a proposal announced by Senator Charles Percy, but not formally introduced in the 94th Congress, move away from melding ocean functions into the general Interior-oriented programs. This tendency is significant because of its implication that ocean resources and programs have unique qualities that may require them to be approached in a specific rather than functional manner.

The Department of Energy and Natural Resources Act (S. 3339), while not transferring any ocean-related programs to the DENR, instructs it to "explore and survey the earth, the atmosphere, and the oceans."[51]

Presumably, such functions would be those normally embodied in the activities of the U.S. Geolog-

[50] Ibid. p. S 17855.

[51] U.S. Congress, Senate. Department of Energy and Natural Resources Act. 94th Cong., 2d sess., 1976, S. 3339, Sec. 5(a).

ical Survey and the Bureau of Land Management, which have responsibilities for the administration of the Outer Continental Shelf Lands. This bill, having been introduced by Senator Abraham Ribicoff, Chairman of the Senate Committee on Government Operations, is considered to be the stalking horse for the generic class of energy-natural resource reorganization legislation that preceded the creation of the Department of Energy in 1977.

Senator Charles H. Percy announced his intention to introduce a bill in the 95th Congress to create a Department of Energy Supply and Natural Resources (DESNR).[52] Like the Ribicoff DENR proposal, the Percy DESNR concept would affect the ocean programs lying outside the Department of the Interior very little.

Two bills introduced in the 94th Congress proposed to merge ocean activities into a broad-based natural resources agency similar to the original DNR concepts of the 92d Congress. The Resource Policy Reorganization Act of 1975 (S. 2726) proposed both a sweeping reorganization of Federal resource and energy programs and legislative reorganization to create a joint committee for oversight and policy. Under the scheme of S. 2726, all of the functions of NOAA, the civil functions of the Corps of Engineers and the Board of Engineers for Rivers and Harbors, would be transferred to a newly created Department of Natural Resources. While Section 213 of the bill refers to transfer of organizational entities into an "Oceanic, Atmospheric, and Earth Sciences Administration," such an administration is not created by Section 203, which sets out the internal organization of DNR. Because of this inconsistency one is not able to comprehend fully how ocean programs would be administered within the proposed organization. It is reasonable to assume, however, that ocean functions would be under the cognizance of the Earth Sciences Administration created in Section 203.

A comprehensive reorganization proposal was made in S. 27, a bill which would create a Department of Natural Resources and Environment. The bill proposed a Cabinet-level department which would encompass the functions of the Department of the Interior (except the Bureau of Indian Affairs and the Office of Territories), NOAA, civil functions of the Corps of Engineers, Board of Engineers for Rivers and Harbors, and related coastal engineering activities as well as the U.S. Forest Service, Soil Conservation Service, and resource components of the Agricultural Research Service and Economic Research Service of the Department of Agriculture, functions of the Pipeline Safety Office of the Department of Transportation, Water Resources Council, ERDA, NRC, and FEA. To the extent that DNRE would combine the functions of oceans and environment in a single agency, the proposal parallels the proposal for a Department of Environment and Oceans (DEO) in S. 3889.

Outer Continental Shelf Management Reorganization

Far-reaching revisions of the Outer Continental Shelf Lands Act of 1953 have been introduced in each Congress from the 92d through the 95th. Each of these would invoke major changes in the bidding system on OCS oil and gas leases and would significantly change the administration of offshore resource management. However, the bills would not affect the inherent authority of the Bureau of Land Management (BLM) to administer the leasing program in the Outer Continental Shelf lands, nor would the internal organization of the Department of the Interior be affected.

Some observers have proposed the creation of a "wet leasing" agency which would assume the authority for administering OCS lands and establish a center of expertise for administering Federal submerged lands. A proposal which would go part way toward accomplishing this was introduced in H.R. 15527 of the 94th Congress, the "Outer Continental Shelf Management Reorganization Act." The bill would establish an Office of Assistant Secretary for Outer Continental Shelf matters within the Department of the Interior. All functions within the Department of the Interior dealing with the Outer Continental Shelf with the exception of cartographic and surveying functions of the USGS, would be transferred to the Assistant Secretary. Other functions dealing with the placement or use of artificial islands, fixed structures, or pipelines in the navigational waters or within the coastal zone which are performed by the Department of Energy. Interstate Commerce Commission (ICC), Department of Transportation (DOT), and the Corps of Engineers, would also be transferred to the Assistant Secretary's Office.

The bill provides for the establishment of an Outer Continental Shelf Council consisting of the Assistant Secretary, the Administrators of EPA and ERDA, the Chief of Engineers, a representative of the Secretary of Commerce and, in the case of decisions affecting other agencies, the head of the affected agency or governor of an affected State. The OCS Council could review any decision made by the Secretary of the Interior which would affect an agency from which a function was previously transferred. Any agency or department taking an action which would "directly and significantly"

[52] U.S. Congress, Senate. Senator Charles Percy announcing his intention to create a Department of Energy Supply and Natural Resources. 94th Cong., 2d sess., 28 September 1976, *Congressional Record* 122: S 16944.

affect the Outer Continental Shelf or its development would be required to report such action to the Secretary of the Interior, who makes amendatory recommendations to the Council for final determination.

The Office of the Assistant Secretary for Outer Continental Shelf Matters would also serve as clearing-house and focus for liaison with State and local governments through a Division of State and Local Liaison.

To a limited extent, the infrastructure proposed in the bill (H.R. 15527) is responsive to the need for an ocean management capability in the Federal Government to regulate the growing use of offshore areas and resolve use conflicts.

Need for Long-Range Resource Planning

Comprehensive resource management requires continued future planning. Functional management within the departments and agencies often fails to provide the integrated long-range planning necessary to promote wise resource use. H.R. 2332 of the 94th Congress proposed the creation of an "Agency for Economic and Natural Resources Planning" within the Executive Branch. The responsibility for resource and economic planning would be divided between two Assistant Administrators.

Setting Priorities: The Budget Process

While congressional authorizations, in a sense, determine the "qualitative" characteristics and content of Federal programs, it is the budget process and appropriations that determine the "quantitative" aspects of such programs. Priorities of Government are set by the budget process. In a real sense, the budget process is also a major determinant in establishing ocean policy. Budget decisions not only serve to allocate funds among major governmental activities, but decisions must also be made among alternative programs within each major budget category. The outcome of such decisions influences the magnitude and direction of the Federal programs, hence the impact of functional policy. The budget process also plays a significant role in coordinating and resolving key issues that filter through the agencies into the Office of Management and Budget via the budget process. Balance may thus be maintained among competing agencies; and duplication and overlap can be controlled.

The Office of Management and Budget (OMB), created pursuant to Reorganization Plan No. 2 of 1970, superseded the old Bureau of the Budget. OMB's functions embrace a broad set of activities dealing with budget formulation, policy planning, policy assessment, and policy coordination. As part of the Executive Office of the President, it is considered to be an extension of the President himself, and therefore is protected by executive privilege, although the Director of OMB must now be confirmed by the Senate.

The budget process is not wholly internal to OMB. Departmental review of agency budget proposals during the budget process involves a series of budgetary decisions on programs and directions as the proposals pass from agency submission to final secretarial approval. Offices compete actively to "sell" their programs in the budget process. Whether policy decisions are consciously part of the departmental review process depends on the department's operating procedures. Nevertheless, policy decisions are made in the process of budget review from proposal to final submission of the President's budget to the Congress and the process does not stop there. Congress imposes its set of priorities through the budget resolution-authorization-appropriation process.

The politics of the budget in the Executive Branch are similar to the politics of appropriations in the legislative branch. Enactment of the Congressional Budget Control and Impoundment Act of 1974, which requires the Congress to set a congressional ceiling on Government spending just as the President must do, has made the congressional budget process even more similar to the executive budget process.[53]

The organization of OMB for budget purposes reflects a modified functional breakdown of governmental activities. Ocean affairs are fragmented among eight divisions: International Affairs; Energy and Food; Economics and Government; Natural Resources; National Security; Human Resources; Science, Space and Energy Technology; and Community and Veterans Affairs. On the surface of the OMB budget organization there is even less consolidation in dealing with ocean-related budget items than there is in the overall organization of ocean programs in the agencies. The OMB budget organization is, in part, dictated by the organization of the President's budget document and, in part, by the jurisdictions of the appropriations subcommittee in the Congress.

While the divisional organization of OMB parallels a logical functional breakdown, ocean programs are assigned among the budget divisions according to the organization in which they reside. Thus, while NOAA, MarAd, and the U.S. Coast Guard programs are reviewed by the Economics and Govern-

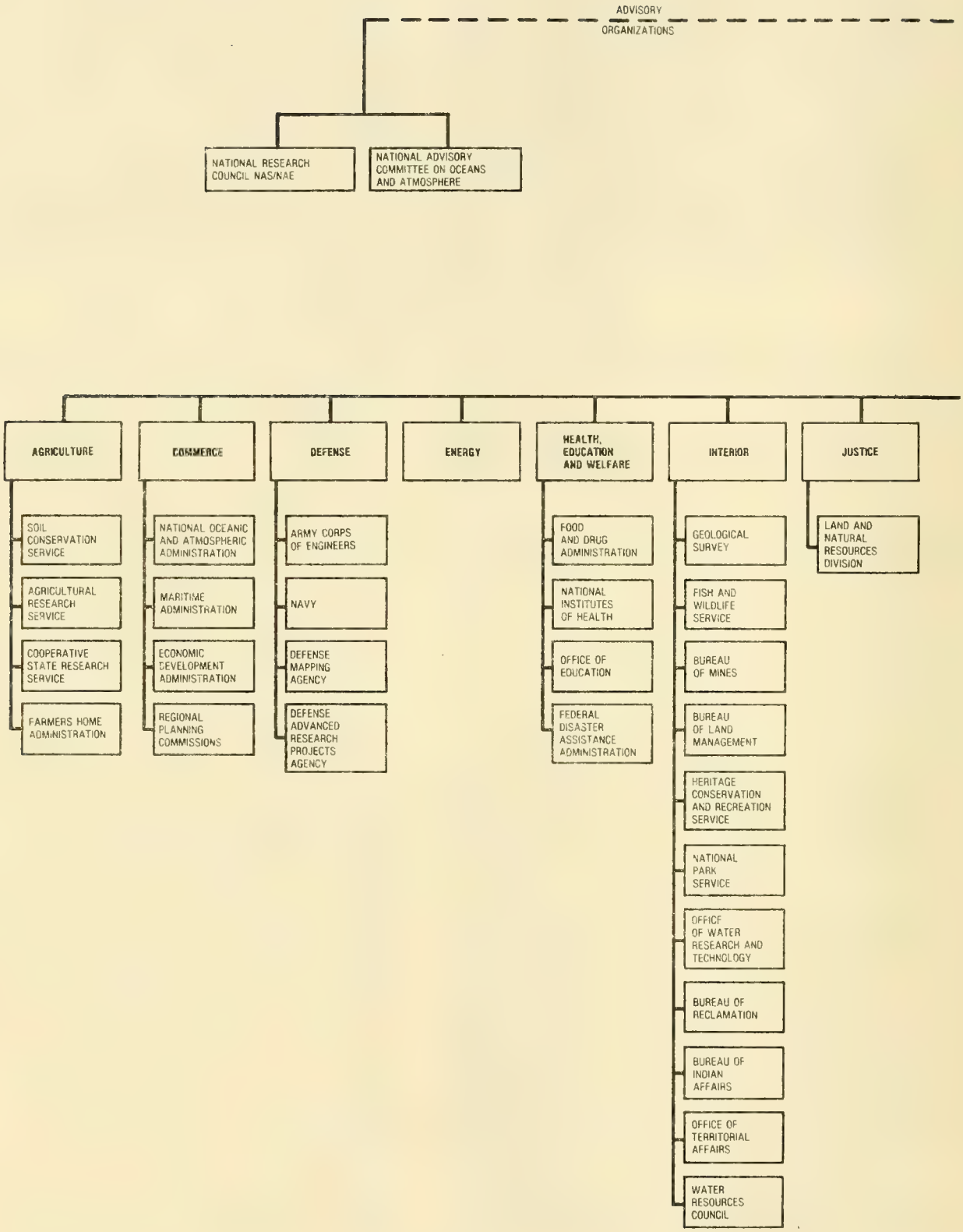
[53] Public Law 93–344; 88 Stat. 297.

ment Division, most Department of the Interior programs, including those of the U.S. Geological survey, are reviewed in the Natural Resources Division, and programs of the Bureau of Mines are considered by the Interior Department Branch. To the extent that the responsible budget analysts coordinate with their counterparts in other budget divisions, the fragmentation of the budget for ocean-related activities can be partially overcome.

Although it would be a difficult task, it is entirely possible to reassign budget responsibilities among the functional divisions of OMB to improve the comprehensiveness of the "ocean budget" review. This could be achieved even in the absence of general governmental reorganization. The question obviously is whether the improved examination would be worth the difficulty in bringing about the reorganization, and whether it can be done for ocean agency budgets without disruptive effects on other agency reviews.

The budget process, from program to agency to department and OMB, and through the President, is a quasi-adversarial proceeding of endless negotiations. Budget offices at all levels are cast in the role of critics. Appeals of budget decisions to higher authorities are available at all stages in the budget process, including the ability of Cabinet Officers to appeal OMB decisions to the President for final resolution, although this is rarely done.

Whether budget decisions drive the policy, or whether policy decisions drive the budget is an important unknown. In any event, the budget is an imperfect decision mechanism. Zero-based budgeting, however, has the potential for bringing policy-making and the budget into closer correspondence.


ADVISORY ORGANIZATIONS
NATIONAL RESEARCH COUNCIL NAS/NAE
NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE
AGRICULTURE
SOIL CONSERVATION SERVICE
AGRICULTURAL RESEARCH SERVICE
COOPERATIVE STATE RESEARCH SERVICE
FARMERS HOME ADMINISTRATION
COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
MARITIME ADMINISTRATION
ECONOMIC DEVELOPMENT ADMINISTRATION
REGIONAL PLANNING COMMISSIONS
DEFENSE
ARMY CORPS OF ENGINEERS
NAVY
DEFENSE MAPPING AGENCY
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
ENERGY
HEALTH, EDUCATION AND WELFARE
FOOD AND DRUG ADMINISTRATION
NATIONAL INSTITUTES OF HEALTH
OFFICE OF EDUCATION
FEDERAL DISASTER ASSISTANCE ADMINISTRATION
INTERIOR
GEOLOGICAL SURVEY
FISH AND WILDLIFE SERVICE
BUREAU OF MINES
BUREAU OF LAND MANAGEMENT
HERITAGE CONSERVATION AND RECREATION SERVICE
NATIONAL PARK SERVICE
OFFICE OF WATER RESEARCH AND TECHNOLOGY
BUREAU OF RECLAMATION
BUREAU OF INDIAN AFFAIRS
OFFICE OF TERRITORIAL AFFAIRS
WATER RESOURCES COUNCIL
JUSTICE
LAND AND NATURAL RESOURCES DIVISION

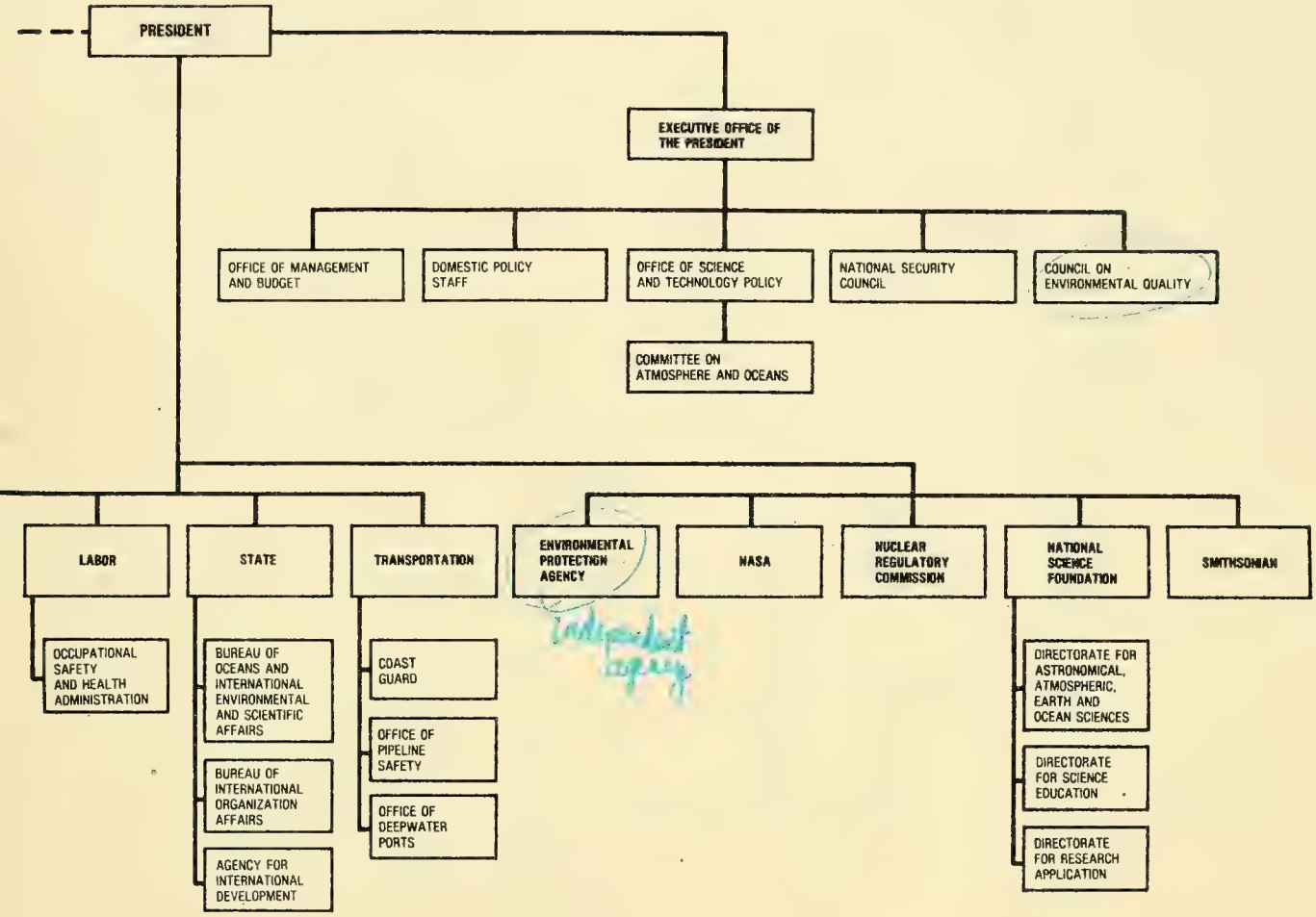
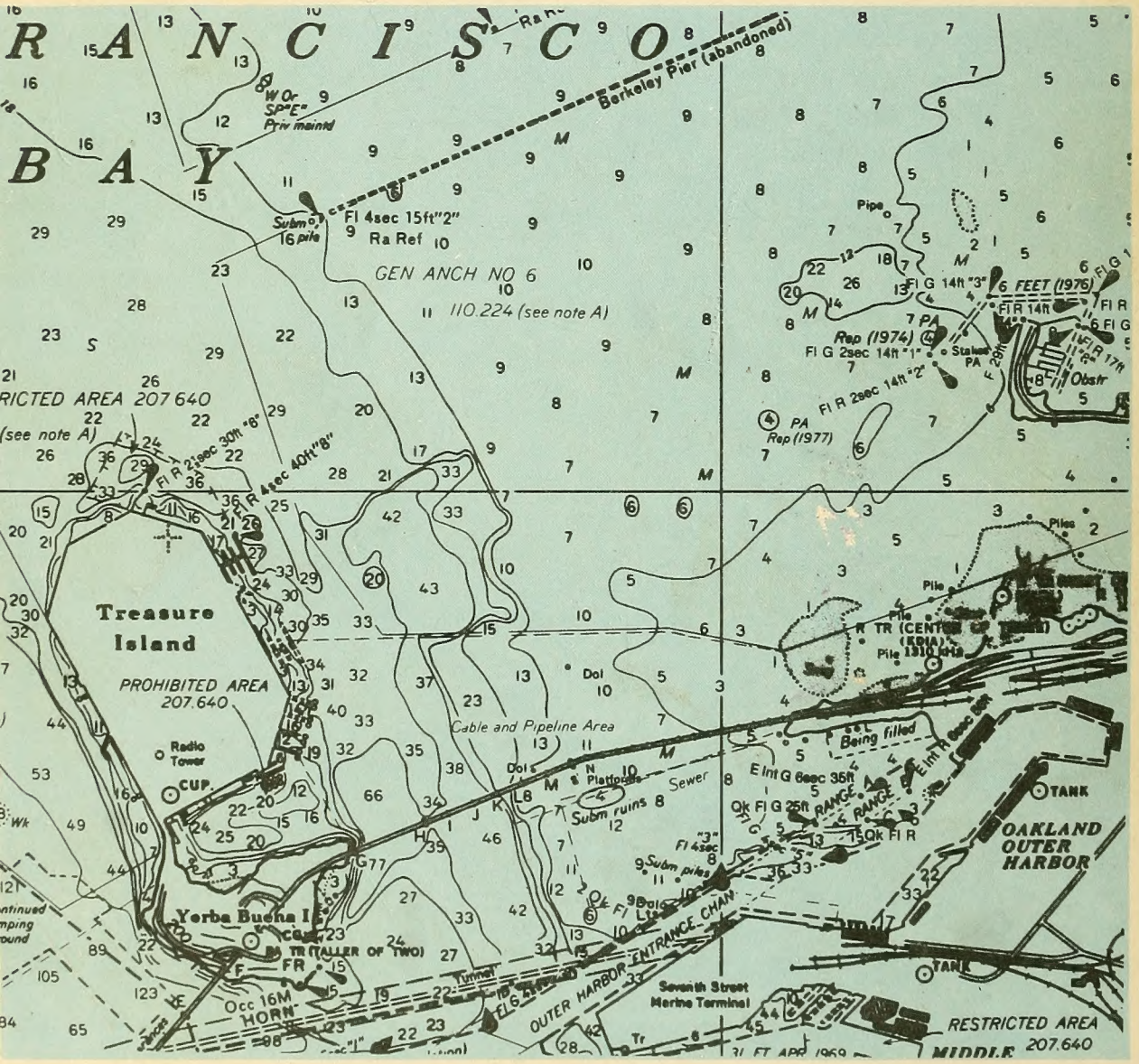


Figure 9-1. – Departments and agencies administering ocean programs in 1977.

☆U.S. GOVERNMENT PRINTING OFFICE: 1979 626-354/1574 1-3



RANCISCO
BAY
Berkeley Pier (abandoned)
W Or SP"E" Priv maintd
Fl 4sec 15ft"2"
Ra Ref
GEN ANCH NO 6
110.224 (see note A)
RICTED AREA 207 640
(see note A)
Fl R 2sec 30ft "8"
Fl R 4sec 40ft"8"
Treasure Island
PROHIBITED AREA 207.640
Radio Tower
CUP
Yerba Buena I
TR (TALLER OF TWO)
Occ 16M
HORN
Cable and Pipeline Area
Dol
Platforms
Sewer
Subm ruins
Subm piles
Being filled
E Int G 6sec 35ft
Qk Fl G 25ft
RANGE
Qk Fl R
Fl 4sec
OUTER HARBOR ENTRANCE CHAN
Tunnel
Seventh Street Marine Terminal
Pipe
Fl G 14ft "3"
6 FEET (1976)
Fl R 14ft
Rep (1974)
Fl G 2sec 14ft "1"
Fl R 2sec 14ft "2"
Stakes PA
Obstr
PA Rep (1977)
Piles
Pile
R TR (CENTER OF TRAIL) (KDIA)
Pile 1310 kHz
TANK
OAKLAND OUTER HARBOR
RESTRICTED AREA 207.640
MIDDLE
31 FT APR 1969